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NOVEMBER 1944

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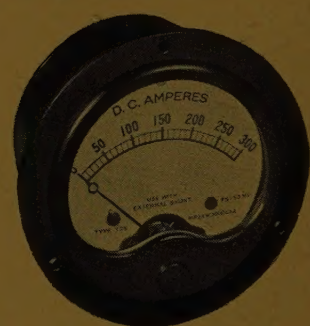

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The Cover: View of 199,000-horsepower power development of Shawinigan Water and Power Company on St. Maurice River at Grand'Mère, Quebec, Canada. Efficient operation of such systems is the subject of an article in this issue.

TRANSACTIONS SECTION

(Follows EE page 424; a preprint of pages 773–868 of the 1944 volume)

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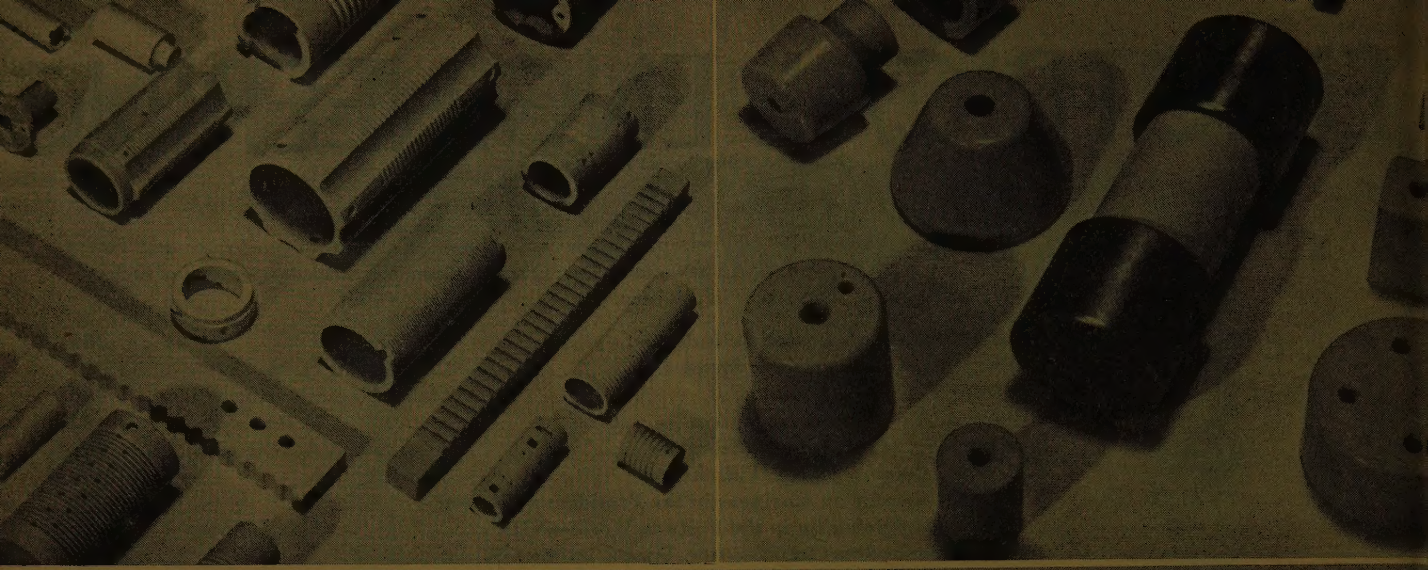

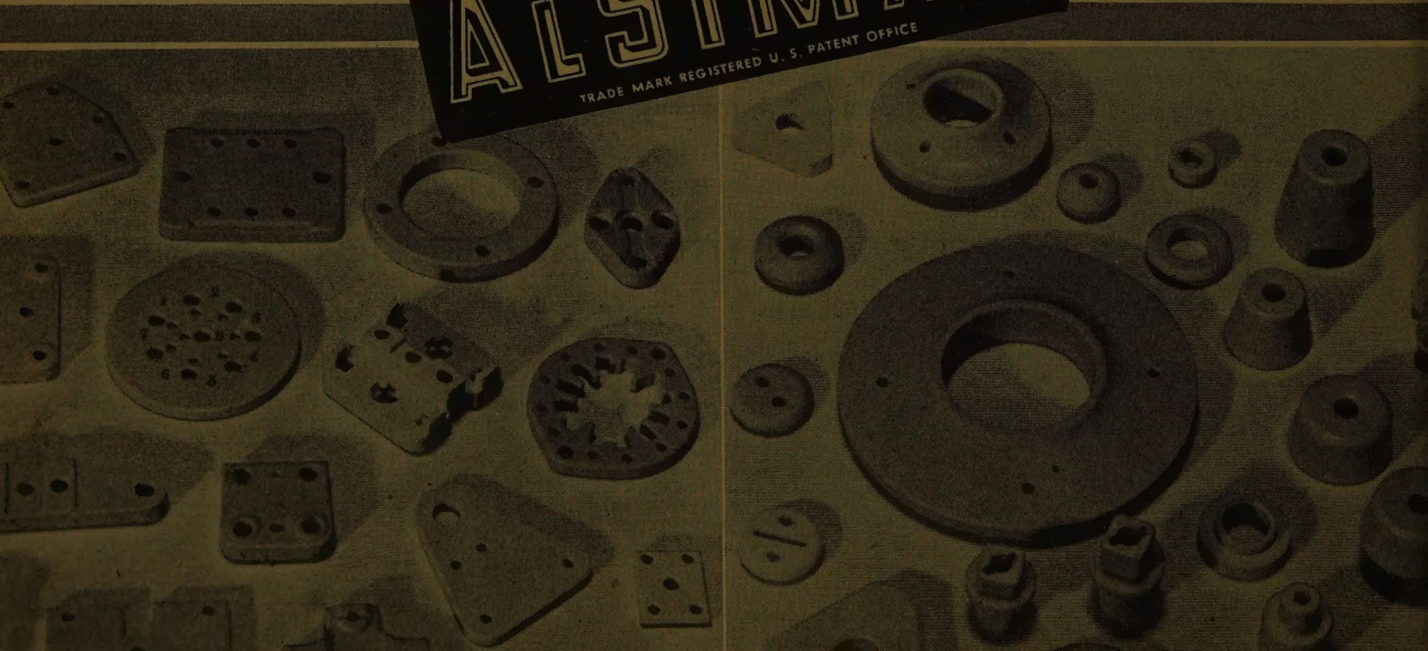

ELECTRICAL ENGINEERING
VOLUME 63, NUMBER 11 NOVEMBER 1944

Retain Germany's Peacetime Industry!

Urge Presidents of Five National Engineering Societies

Declaring that the proposed destruction of Germany's entire industrial plant is economically unsound and contains the seeds of a new war, the presidents of the American societies of civil, mining and metallurgical, mechanical, electrical, and chemical engineers, in a jointly signed statement recently released to the press, urge that only that part of German industry devoted to armament be destroyed. Although prepared specifically as a criticism of Secretary of the Treasury Henry Morgenthau's proposal of a wholly agricultural postwar economy for Germany, it is an equally apt criticism of all proposals calling for indiscriminate destruction of the German industrial economy. Full text of the statement is presented here. The presidents of these societies also are taking steps through appropriate channels toward assuring that engineering advice be brought to bear on peace problems.

ON the basis of our experience in engineering and industry, we consider that the proposal of the Secretary of the Treasury for the control of postwar Germany by the destruction or virtual dissolution of her industrial plant is economically unsound and contains the seeds of a new war. We believe that the part played by over 75,000 members of these societies in the design, engineering and production of the implements for our Armed Forces in quantities adequate for Victory, as well as our long experience as engineering industrialists in peacetime, entitle us to speak on this subject of paramount importance to the peace of the world.

In general, the Morgenthau proposal is indefensible because the destruction of the machines, utilities, tools, materials, and other essentials for peacetime living penalizes not only the owners of the materials destroyed, but the world as a whole. Specifically, the fundamental fallacy of the proposal for the indiscriminate destruction of the German industrial system is that it fails to differentiate between the wartime and the peacetime economy of the Reich.

We are for one simple, clear objective—an effective industrial means to keep Germany from starting another war. This objective should not be confused, especially before the war is even won, with the appropriate punishment of Germany or with the international arrangements for the long future to be made around the peace table by the representatives of the Allied Nations after victory is achieved. This statement, therefore, deals not with broad, complex, postwar questions of diplomacy and international policy, but simply and solely with the suggestion for the indiscriminate dismemberment of the German industrial economy.

"Unconditional surrender" implies disarmament of the German armies, the surrender of all arms, munitions, airplanes, and other ordnance matériel in stock piles or in process. It also should include the elimination of all German war production facilities such as aircraft plants, munitions plants, and submarine works, and the control of raw materials required by war industries.

We make no suggestions as to the over-all international treatment of Germany after surrender, but confine our statement to the physical disarmament of Germany and to the subsequent steps to make it impossible for her to prepare industrially for another war. With this sole aim in view, however, we must recognize that the German nation cannot arbitrarily be kept in economic and industrial subjugation. To do so would create an economic vacuum in Europe which sooner or later would be filled, either by the German nation itself or by the collaboration of Germany with other nations or individuals who would profit financially or politically, or both, by helping to develop Germany into a good market.

Germany must have its chance for recovery along peaceful lines after the war. Such recovery cannot come about through an economy wholly agricultural, even if that were practicable; or without industry to produce both for German needs and for the reconstruction of other nations of Europe; or without markets.

It is farthest from any suggestion of a so-called "soft peace" to recognize this fact. Germany must be disarmed and that part of its industrial plant devoted to armament destroyed. But it is equally necessary to create a plan which will (*a*) allow the German people to live a reasonably normal life; (*b*) permit the retention of German industry to help in the vast task of restitution and reconstruction, and (*c*) keep an economic balance in Europe. This, we are confident, can be done without giving German industry the independence it would require to prepare for war again, either secretly or overtly.

We recommend, therefore, not an indiscriminate destruction, but a selective restriction and control of German industry. Germany and Europe and the world need the contributions which the German nation, freed from the domination of war lords, can make in the future, as it has made in the past, to the development of modern technology and scientific and industrial advance.

If allied controls force the German people into an unnatural existence and hold back national economic development in Europe, they will become even more unstable and subject to pressures and possibilities containing the explosive seeds of another war. We should plan, therefore, to create a minimum of controls and to avoid abnormal social dislocations.

Discriminating between peace and war economy, there are at least six industries which are the most essential for war purposes, and the least essential for a peacetime economy. They are: synthetic gasoline, for which there is no economical peacetime use; manufacture of explosives; airplane production; use of aluminum and magnesium; high alloy and electrolytic steels; and nitrogen fixation, all of which must be vastly expanded to prepare for war. The labor employed by all these six industries in peacetime is less than two per cent of the total German labor force.

Therefore, Germany's capacity to make war would be eliminated by the following steps in regard to its industrial economy:

1. Eliminate all synthetic-oil capacity and prohibit the reconstruction of plants and the importation of oil beyond normal peacetime in-

ventories. This would destroy the major part of Germany's internal oil resources. Coal is the raw material for synthetic oil. It is plentiful in Germany and only a small per cent is used in synthetic-oil plants. It is not readily controllable in the Reich.

2. Eliminate 75 per cent of Germany's synthetic-nitrogen plant capacity and prohibit reconstruction of plants and all importation of nitrogen compounds. This will leave a capacity in Germany ample for peacetime nitrogen requirements. The principal ingredient of explosives is nitrogen. The relatively small amount of dynamite required for mining, quarrying, and so forth, should be under import control.

3. Eliminate 50 per cent of Germany's steel-making capacity in those categories of plants which are most capable of producing essential war materials such as heavy forgings, electrolytic and high alloy steels. Manganese, chromium, nickel, and tungsten are practically nonexistent in Germany. Also prohibit importation of iron ore, flux material, steel, and steel products beyond normal peacetime inventories.

4. Eliminate aircraft plants and equipment. Aluminum and magnesium are the raw materials required for airplane manufacture. There are no important bauxite deposits in Germany. Importation should be prohibited. Aluminum and aluminum plants should be destroyed and importation of aluminum ingots beyond prewar peacetime needs be prohibited.

If any *one* of these steps were taken, war could not be waged nor prepared for. Taking all four would afford ample insurance against war.

By attacking the problem from this angle, it would be possible to set up uncomplicated, nonpolitical controls to prevent the rearmament of Germany, but at the same time make it possible for the German nation to meet its own peacetime needs and thereby prevent her from becoming a drag on the economy of all Europe and a breeder of future wars.

Fifty or 60 per cent of the German oil and gasoline supplies have come from synthetic-coal distillation plants scattered throughout Germany. A third of her requirements has been derived from the Ploesti oil field in Rumania. The synthetic plants produce inferior products at a cost about four times world prices. Their operation has required Government subsidy. These war plants should be demolished.

Eighty per cent of nitrogen is produced synthetically from the air, but it could not be produced without reconstruction of special plants or without Chilean nitrates which Germany must import. Germany could not make steel, produce oil products, or make munitions of war without imports of bulky easy-to-police materials. Hence policing the curtailment of potential war production would consist of: (*a*) controlling the imports of, or the accumulation of stocks of, such bulk materials as petroleum, pyrites, or brimstone, manganese, chrome ore and iron ore, steel, aluminum, and nitrogen compounds; and (*b*) requiring periodic inspections of plants and special revocable permits of construction or of operation of manufacturing facilities for any purpose. Further insurance could be secured by transferring the ownership or management of nitrogen and steel production plants into allied hands.

Under such a plan Germany still could re-establish a productive economy for nonmilitary purposes. It would leave Germany economically free to expand along peaceful lines, and give her a competitive position in international commerce with other nations burdened with high debt charges, the maintenance of armies and navies, rehabilitation costs, and so forth.

A large part of the determined peacetime productive capacity of Germany should be turned immediately, and for a long period, to the manufacture of restitution materials for war-damaged countries. The percentage of industry turned to this purpose should be the maximum possible without reducing the people to a submarginal level.

When the Allied Nations presently have rendered Germany harmless by disarmament for the next 10 or 15 years, a program of permanently disarming her must look not to 15 but to 50 years. It is unrealistic to assume that any program put forward to take the sting out of Germany will not require supervision and vigilance for a long period in the future.

The essence of this program is to remove from Germany the plant and source materials essential for war purposes, but to do it with the least disturbance to the normal economy of Western Europe.

Engineers play an essential part in providing employment in the economy of any nation. In this country especially they see their function not in narrow, professional terms, but in providing jobs and in promoting industrial production. They do not believe that crippling the normal peacetime industrial economy of any country, even an enemy nation, can promote world peace and reconstruction. On the contrary, such a policy jeopardizes the peace and progress of all. We are opposed to any plan which would make postwar Germany a drag on the economy of all Europe, if not of the world, and a breeder of future wars.

Malcolm Pirnie, President, American Society of Civil Engineers

Chester A. Fulton, President, American Institute of Mining and Metallurgical Engineers, Inc.

Robert M. Gates, President, The American Society of Mechanical Engineers

Charles A. Powel, President, American Institute of Electrical Engineers

George G. Brown, President, American Institute of Chemical Engineers

Wind-Tunnel Testing

This giant wind tunnel for testing full-size airplanes under simulated conditions, built and operated by the National Advisory Committee on Aeronautics in Ames Aeronautical Laboratory, Moffett Field, Calif., contains six 6,000-horsepower Westinghouse motors. Each of the 57-ton motors drives a six-bladed spruce fan 40 feet in diameter. As shown, the motors are mounted in two horizontal rows of three in a 90- by 128-foot portion of the tunnel. Center line of the top row of motors is about 90 feet above ground level. The basic purpose for the Ames Laboratory wind tunnel is to enable the designing and building of faster, safer, and more efficient aircraft. The test section of the tunnel is 80 feet wide and 40 feet high, thus allowing for the testing of full-size airplanes, including some of the two-engine type. The major problem for solution by wind-tunnel testing deals with reducing the effect of forces which impede forward motion of an airplane.

Efficient Operation of Hydroelectric Systems

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The careful testing of each generating unit and the setting up of loading schedules similar to those commonly used on steam-electric systems will pay generous dividends in efficiency of operation of a hydroelectric system, these authors conclude from their experience with the system described in this article.

THE PROBLEM of efficient operation of hydroelectric systems is one which must be familiar to all engineers engaged in the operation of such power systems, but it does not appear to be given very much attention in the technical press or other publications. One sees frequent mention of the high efficiency of steam-electric stations, generally given to the second or third decimal place, and the loading schedules for such stations usually are based on a detailed analysis of incremental costs. Descriptions of hydroelectric plants, however, are generally limited to the size of the units and spectacular details of the construction.

This situation with regard to hydroelectric stations probably has arisen from the fact that the problem of operating several hydroelectric plants at best over-all efficiency is much more complex than the parallel problem with steam plants. In the first place the source of energy is seldom under close control and is subject to unexpected variations. In addition, this potential energy seldom can be stored in quantity within a short distance of the point of use. With coal-burning plants, if it is found that a certain block of electric power can be produced by burning nine tons of coal at one plant or ten tons at another, the obvious solution is to burn the nine tons and leave the ten on the coal pile of the second plant. In the case of hydroelectric plants, the study must be carried further to determine whether the ten tons will remain on the pile until such time as they can be used to advantage.

No matter what the arrangement of the system may be, it is obvious that the first requirement for efficient operation is to determine the characteristics of each individual generating station. In the past, some hydroelectric-system operators probably have been deterred from checking the characteristics of their prime movers by the apparent difficulty and cost of measuring large flows of water with a reasonable degree of accuracy. As a matter of fact, when these flows are confined to regular passages such as intakes and penstocks of turbines, their measurement seldom is difficult, and the cost generally is insignificant compared with the value of the information which may be obtained.

THREE METHODS OF FLOW MEASUREMENT

There are three widely accepted methods of flow measurement used in North America for the determination of turbine discharge and, generally speaking, each one is particularly suited to one certain type of installation. The salt velocity method, developed by C. M. Allen of Worcester Polytechnic Institute, is based on the time required for a charge of electrolyte, injected into the stream, to pass from one set of electrodes to another set further downstream in a well-defined water passage. Obviously, the electrodes must be far enough apart to give a time interval which can be measured readily with a fair degree of accuracy. The installation of the electrodes and electrolyte-injection equipment generally requires a shutdown of the unit for a number of hours or even days, but the test can be conducted without causing any noticeable system disturbances. It is an empirical method, and some experience in interpreting the test data is necessary to insure accurate results.

Figure 1 is a reproduction of a section of a salt velocity record. The arrival of the salt solution at the upper and lower electrodes is indicated clearly, and the elapsed time is measured by means of the dots at the upper edge of the chart. Figure 2 illustrates an installation which can be tested most readily by means of the salt velocity method. The intake tunnel is long enough to give adequate intervals, and the test electrodes can be installed readily in the level sections.

The Gibson method developed by Norman Gibson of the Niagara Falls Power Company, is based on the measurement of the energy contained in a well-defined section of the stream. When the flow is arrested at the outlet, the product of the pressure rise which occurs and the time during which it is present is a function of the original energy in the stream. This method provides a means of recording and measuring this product of pressure and time and, when the dimensions of the conduit have been determined, the velocity of the stream may be calculated readily from these data. The installation of the test equipment frequently can be made without shutting down the unit, but the actual testing may cause serious voltage and frequency disturbances, unless the system is large enough to absorb the sudden loss of output of the unit.

A typical record of a Gibson test is shown in Figure 3. The energy of the stream is represented by the dark area above the line *OML* in which vertical distances are proportional to pressure and horizontal distances to time. Figure 4 illustrates a type of station to which the Gibson method is particularly applicable. The necessary piezometers were installed during the construction of the plant, and tests now can be made with very little preparation and at a negligible cost.

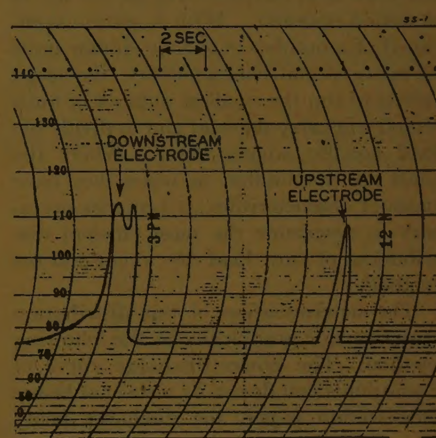

Figure 1. Salt velocity chart

The "current-meter method" was developed in Europe and has gained favor in Canada only in the last few years. It consists of measuring the velocity at numerous points at some section of the water passage, generally the intake, and combining these measurements to find the average velocity of the whole stream. Generally the equipment can be installed and the test carried out without any interference with operation, but the metering section must be so located that the flow is reasonably streamlined, and is not far from normal to the metering section.

A portion of the record chart of a current-meter test is shown in Figure 5. In this case nine meters were in operation simultaneously, the tenth trace being a record of elapsed time. This method is generally best adapted to the testing of low-head installations such as that shown in Figure 6 where the intake passages are generally too large and short for the economical application of other testing methods.

The data obtained from any efficiency

Essential substance of a paper presented before the AIEE Montreal Section, Montreal, Quebec, Canada, May 5, 1944.

L. B. Stirling is superintendent of generating stations, Shawinigan Water and Power Company, Shawinigan Falls, Quebec, Canada, and **J. M. Sharpe** is assistant superintendent of operation, Shawinigan Water and Power Company, Montreal, Quebec, Canada.

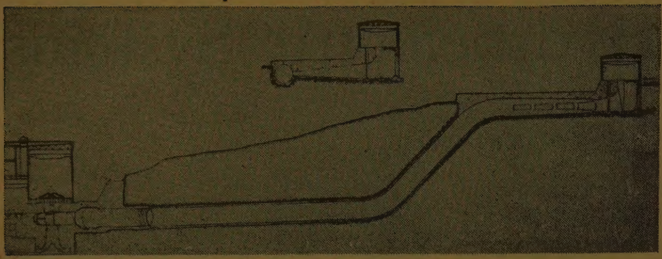

Figure 2. Unit 6–2, Shawinigan Falls

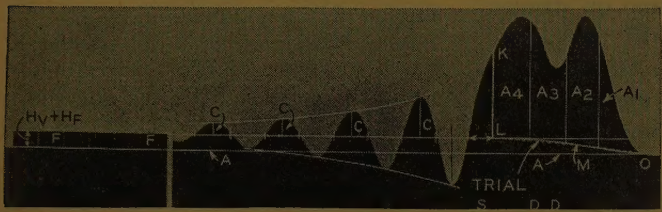

Figure 3. Gibson chart

test of a unit are generally arranged as shown by the curves in Figure 7. These give all the information necessary to plan an efficient loading schedule, but they do not show it in suitable form for the use of a station operator. With a station composed of a number of exactly similar units of conventional characteristics, the usual rule is to run the smallest number of units which will carry the load and to divide the load equally among them. Where the units are not similar, or when they have unusual characteristics, it becomes necessary to determine the most efficient distribution of any load by a cut-and-try method.

The determination of this distribution may be made graphically by the following method: The power–discharge curve of each unit is first drawn on a sheet of heavy cross-section paper, the discharge being plotted horizontally and the power output vertically. These sheets then are cut along the plotted curves to form templates. One template is inverted and fastened to a drawing table in this position. A second template, in the upright position, is laid over it with the bottom edge resting against a T square, as shown in Figure 8. In this position each abscissa represents a definite output, and its length is proportional to the corresponding discharge. As one template is inverted, the sum of the outputs represented by any two abscissae which coincide in a constant. Thus, the loose template is moved vertically until the sum of any two abscissae which coincide equals the total load under consideration, as, 38 kw in Figure 8. Their total length is proportional to the discharge, but this will vary with the distribution of the load. To find the minimum discharge, the loose template is now moved along the T square until a common tangent point of the two curves just appears. The two abscissae which coincide at this tangent represent the most efficient distribution of the load under consideration.

This procedure is repeated for all loads between the capacity of one and two units, and with different combinations of units.

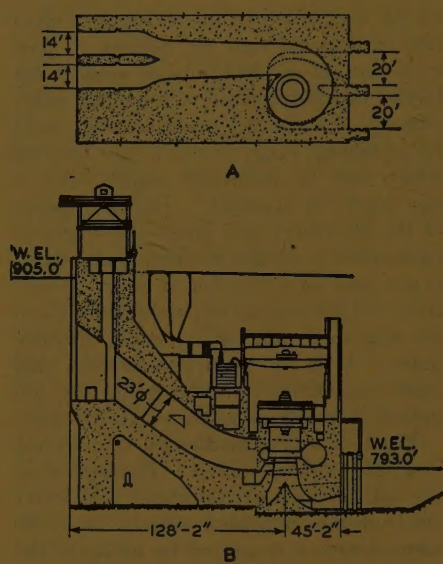

Figure 4. Rapide Blanc power-house unit, 44,400 horsepower

A. Plan at center line of penstock
B. Section through unit

When the most efficient combination of two units, within practical limitations, has been determined, a power–discharge template for two units is made up and the same procedure repeated to find the loading schedule for three units. Eventually the most efficient division of any load is determined and may be plotted as a graph for the guidance of the station operators. A station power–discharge curve also may be made up from these data, and these two curves, together with information on the maximum permissible forebay elevation, will enable an operator to load his station in the most efficient manner.

It is advisable, however, to provide some means of checking the daily operation to determine whether the maximum output has been realized, or whether the customary standard of efficiency is being maintained. One could do this by checking the conditions as recorded on the log sheet hour by hour, but this is extremely laborious and does not give a simple over-all picture of the situation. A better method is to predetermine from the test data and other relevant information the maximum daily output which can be obtained from any river flow and to compare the actual output with this theoretical maximum.

In order to determine this maximum output, the first requirement is to find the maximum head available at any flow. The permissible forebay elevation generally varies with the flow and the tailrace rises as the flow increases, the usual result being that the available head decreases very appreciably at high flows.

It then is assumed that the station can be operated at the peaks of the station efficiency curve only, that is, the average intermediate loads may be carried by operating part of the time at the higher efficiency peak and part at the lower one. With this assumption the station efficiency curve may be taken to be the envelope of the true efficiency curve, and the station discharge as the envelope of the true discharge curve. To determine the maximum output for any station discharge, the first step is to find the head corresponding to that discharge. The portion of the total flow which consists of unit discharges is then found, and the corresponding discharge at the head on which the station discharge curve is based is calculated. This point is located on the discharge envelope, and the corresponding efficiency is determined from the efficiency envelope. When the total unit discharge, the head, and the efficiency are known, the output is readily calculated, and a curve showing the maximum daily output for any station discharge can be made up.

The difference between the maximum and the obtained outputs is the loss due to inefficient operation and, for purposes

Table I

Time	Station Load—Megawatts	Station Discharge—Cubic Feet Per Second	Headrace Elevation
1 a.m.	55.0	11,870	101.2
2	55.0	11,870	101.3
3	55.5	11,835	101.6
4	56.0	11,900	102.0
5	57.0	11,920	102.5
6	57.5	12,010	102.9
7	83.0	17,950	103.3
8	103.0	22,860	103.1
9	104.0	23,040	102.9
10	104.0	23,040	102.8
11	104.0	23,040	102.6
12 N.	103.0	23,215	102.5
1	78.0	18,120	102.9
2	103.5	23,385	102.6
3	103.5	23,385	102.6
4	102.0	22,945	102.5
5	102.0	22,945	102.4
6	102.0	22,945	102.2
7	102.0	22,945	102.0
8	101.0	22,945	101.9
9	101.0	22,945	101.7
10	100.0	23,125	101.5
11	76.0	16,950	101.5
12 M.	77.5	17,410	101.8
Total	2,085.5 megawatts		
Average		19,297	102.2

Figure 5. Portion of current-meter chart, La Gabelle power house

Test of unit 2

of comparison, may be expressed as a percentage. This loss, however, can be broken down readily into the loss due to low head and the loss due to improper loading.

From Table I,

Total power generated from hourly readings = 2,085.5 megawatt-hours.

Total generated from integrating watt-hour meters = 2,090.0 megawatt-hours.

Corrected average discharge = $19{,}297 \times \dfrac{2{,}090.0}{2{,}085.5} = 19{,}423$ cubic feet per second.

Maximum daily output at 19,423 cubic feet per second with headrace elevation at 102.7 = 2,130

Total generated power = 2,090.

Loss = 40.0 megawatt-hours

Maximum head for discharge of 19,423 cubic feet per second = 60.1 feet

Loss in headrace = 102.7 − 102.2 = 0.5 foot.

Loss due to reduced headrace elevation $= 0.5 \times \dfrac{2{,}130}{60.1} = 17.7$ megawatt-hours

Loss due to improper loading = 40.0 − 17.7 = 22.3

The difference between the maximum head, as shown by the curve, and the average daily head is determined, and the maximum output is multiplied by the ratio of this difference to the maximum head. This gives the loss due to low head. The remainder of the loss accordingly must be due to improper loading. It would be possible to break this down further into losses due to frequency control, maintaining spare capacity, and so on, but this would involve a good deal of clerical work and would probably call for additional personnel. The simple breakdown shown herein has been found to be quite satisfactory and can be calculated readily by the normal operating staff.

EFFICIENT OPERATION OF GENERATING SYSTEMS

The foregoing relates to the efficient operation of individual stations. When a number of generating stations are operated together, additional factors have to be considered. The following outlines certain practices which are employed by the Shawinigan Water and Power Company in order to maintain maximum operating efficiencies. It is appreciated that these procedures are not applicable necessarily to all systems since hydroelectric systems differ from one another as black differs from white. What is good practice on one system may be poor practice on another, and what is essential in some cases may be useless under different circumstances.

On systems where both steam- and hydroelectric generation are employed, and particularly where hydroelectric is only a small part of the total capacity, the control of the hydroelectric generation is not so difficult as when the total power supply is from hydroelectric stations. The conditions on the Shawinigan system especially are complicated, because the main generating stations all are located one above the other on the same river—the St. Maurice.

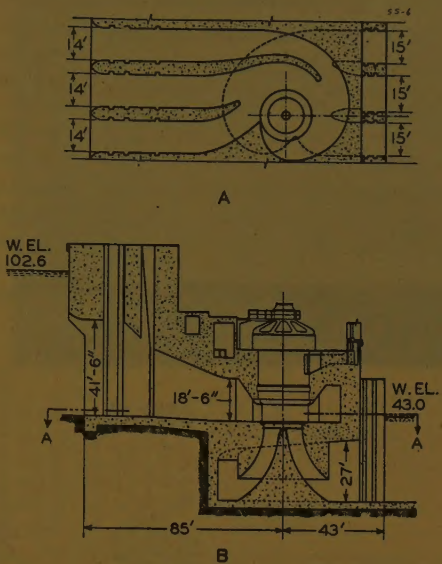

Figure 6. La Gabelle power-house unit, 32,000 horsepower

A. Section A–A

B. Section through unit

Figure 12 shows the relative locations of the stations. The principal characteristics of this system, as far as the subject of this paper is concerned, are as follows:

1. There are ten power sites on this river with a potential capacity of 2,000,000 horsepower. Of these, five sites, with an output of over 1,100,000 horsepower have been developed.

2. The La Gabelle, Shawinigan, and Grand-'Mere stations, with a total capacity of approximately 700,000 horsepower are located within 30 miles of Three Rivers where the St. Maurice discharges into the St. Lawrence.

3. The Rapide Blanc and La Tuque developments, with a total capacity of 422,500 horsepower are located about 100 miles north of Shawinigan Falls.

4. Out of a total drainage area of 15,400 square miles, 6,077 square miles are controlled completely or partially by storage reservoirs with a capacity of over 350,000,000,000 cubic feet. The principal storage is the Gouin Reservoir at the headwaters where 280,000,000,000 cubic feet of capacity is available.

The storage reservoirs, other than Gouin, are filled each year during the flood periods and completely emptied during the months of low or regulated flow. During the spring flood period of an average year the volume of water impounded at the Gouin Reservoir is increased by 80,000,000,000 cubic feet. The normal reserve of 200,000,000,000 cubic feet at Gouin is used to maintain the river flow at required values during years of

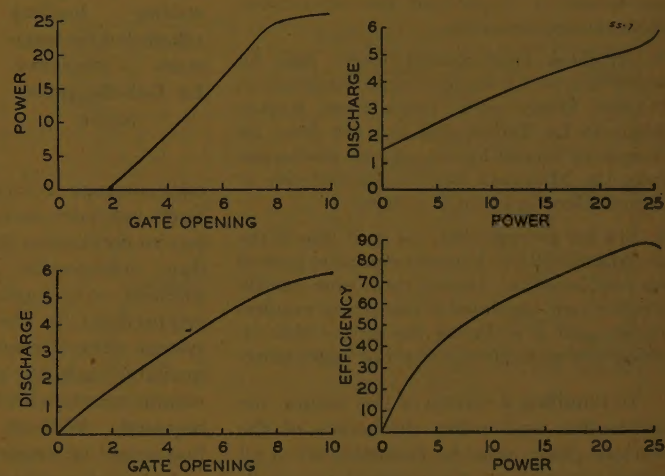

Figure 7. Test result curves

Unit 5—60-foot head

Table II. Comparison of Weekly Operating Efficiencies—Combined Generating Stations on St. Maurice River

Week Ending	March 5, 1944 Kilowatt-Hours	March 5, 1944 Per Cent	January 24, 1943 Kilowatt-Hours	January 24, 1943 Per Cent
Generation possible with water used at maximum head and efficiency	100,278,300	100.00	113,363,000	100.00
Loss due to reduced head	633,900	0.63	1,494,600	1.32
Loss due to improper loading of units	1,041,800	1.04	3,537,400	3.12
Total loss	1,675,700	1.67	5,032,000	4.44
Actual generation	98,602,600	98.33	108,331,000	95.56

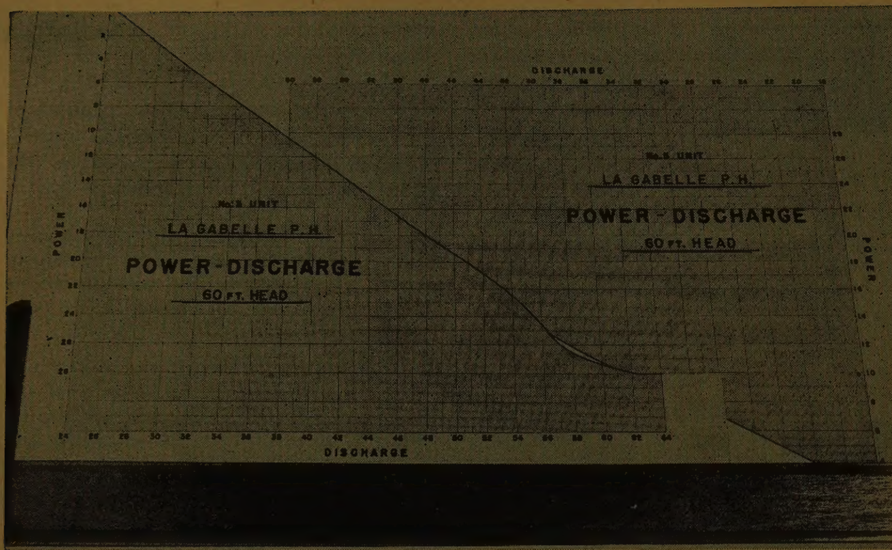

Figure 8. Power–discharge templates

La Gabelle power house—60 feet head
Left—unit 3; right—unit 5

"below-normal" run-off and is replenished in years "above-normal" run off.

The importance of these storage capacities can be seen from the fact that out of an average river flow of 22,500 cubic feet per second at Grand'Mere during the past December, January, and February, 16,500 cubic feet per second or 73 per cent was water taken from storage reservoirs.

5. It takes approximately three days for water to travel from the Gouin Reservoir to Rapide Blanc, eight hours from Rapide Blanc to La Tuque, and one day from La Tuque to Grand'Mere. Water discharged from the Mattawin Reservoir is effective at Grand'Mere in about $1^1/_2$ days.

6. In the average year, the river flow of the St. Maurice River is under complete control for nine months. During these nine months the flows are regulated to suit power requirements, and it is during this period that efficiency of generation is of prime importance.

In handling a system of this nature, the generation and water discharges of the various plants must be co-ordinated at all times to take care of not only the immediate needs, but also the anticipated future requirements of the system as a whole. Forecasts must be maintained, covering the expected daily conditions for a period of at least seven days in advance. From these, the proper distribution of the daily generation and the discharge schedule for each storage reservoir are determined. Such estimates and calculations are subject to continuous revision as more up-to-date information is available. This planned co-ordination is a fundamental requirement for the operation of such a system, since it assures that the river flow available each day at each station will be commensurate with the average generation required. Without this, efficient operation would be impossible.

As stated previously, reduction in efficiency of generation can result from operation of units at less than maximum head and from the improper loading of units.

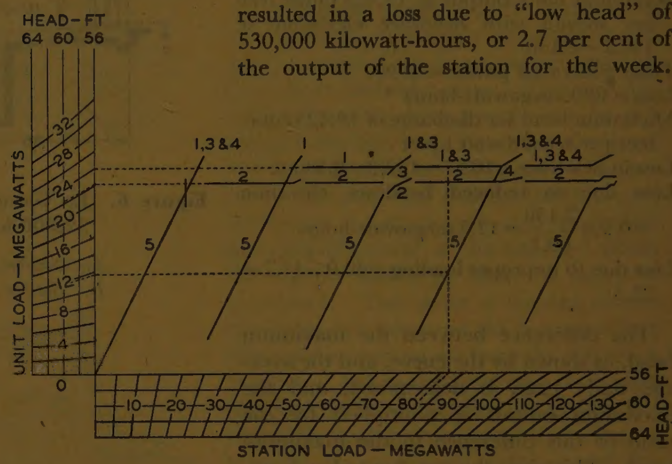

Figure 9. Practical station loading scheduled for maximum efficiency, La Gabelle power house

LOSSES DUE TO LOW HEAD

On such a system, while it is not practicable to eliminate all losses due to "low head," they can be kept to a minimum by careful operation. The control of this item is of particular importance at stations where appreciable forebay pondage exists, and has to be employed in the normal cycle of operation. At the Grand-'Mere Station, for example, it is necessary to draw down the forebay during the week-days so that the water may be stored, instead of spilled, over the light-load period of the weekend when only a portion of the total water inflow is required for discharge through the station for power generation purposes.

Figure 13 shows how the operation actually is controlled in order to obtain the required result with the minimum of losses. If the river flow had been held constant throughout the week, the variation in the forebay elevation would have been as indicated by the dotted line and would have resulted in a loss due to "low head" of 530,000 kilowatt-hours, or 2.7 per cent of the output of the station for the week.

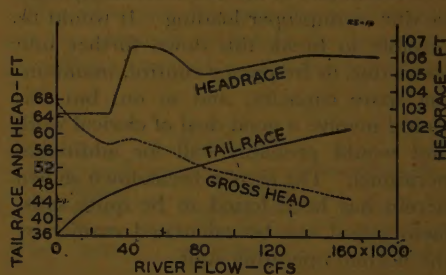

Figure 10. Variation of forebay, tailrace, and head, with flow, La Gabelle power house

By manipulation of the discharge from storage reservoirs, however, the same average flow was obtained but with higher values for the first half of the week and lower for the second half, and with an actual drawdown as shown by the solid line. This resulted in the losses being reduced to just half of what they would otherwise have been.

Under most conditions, the losses due to "low head" at the average station can be held to about three fourths of one per cent.

LOSSES FROM IMPROPER LOADING

The losses due to "improper loading" of units are usually potentially greater than

Table III. Comparison of Weekly Operating Efficiencies—La Gabelle Generating Station

	Week Ending March 5, 1944		January 24, 1943	
	Kilowatt-Hours	Per Cent	Kilowatt-Hours	Per Cent
Generation possible with water used at maximum head and efficiency	14,394,300	100.00	16,620,000	100.00
Loss due to reduced head	32,500	0.22	353,700	2.13
Loss due to improper loading of units	161,800	1.12	1,106,300	6.65
Total loss	194,300	1.34	1,460,000	8.78
Actual generation	14,200,000	98.66	15,160,000	91.22

losses due to "low head" and are more difficult to control.

The maximum possible efficiency of the average generating unit on the St. Maurice River system, as determined by test, is 88 per cent and can be obtained when the unit is operated at 86 per cent of its maximum capacity. If the unit is operated at maximum capacity, or if it is operated at 50 per cent of maximum capacity, the efficiency will drop 8 per cent.

In order to minimize the losses due to "improper loading of units," the general procedure employed in actual practice is to maintain a distribution of the total generation so that all stations, with one exception, will have an assigned output which can be obtained by operating a definite number of generating units with each unit at its point of maximum efficiency. The one exception is the station which is delegated to "frequency control." This station must supply the remainder of the required generation and vary its output to follow the continual changes in total requirements.

At the frequency-controlling station, the generation tends to swing above and below the value corresponding to maximum efficiency, and losses result. If at any time the station becomes loaded to capacity, or if too much spare capacity becomes available, the total generation must be redistributed among the stations concerned.

At stations where all generating units have similar characteristics, the general rule for frequency control, as previously mentioned, is to operate the smallest number of units which will carry the load and to divide the load equally between them. At stations with units which are not similar, or when the units have unusual characteristics, the ideal loading schedule for maximum efficiency may be so complicated that it cannot be followed in actual practice, and some compromise must be made.

When a station is not on frequency control, the problem is to maintain a generation corresponding to a point of maximum efficiency. From a practical point of view, therefore, the essential information required by station operators is with reference to the maximum efficiency point of each individual unit. Knowledge of efficiencies which will be obtained over the whole capacity range of each unit is of secondary importance in most cases, as far as the station operator is concerned.

Where fixed-blade runners are employed, the point of maximum efficiency corresponds to a definite opening of the turbine vanes and should be expressed in this manner as a matter of convenience. The actual output which can be obtained at this efficiency, of course, will vary with the hydraulic head which is available. As a further convenience, it is desirable that remote indication of turbine gate openings be provided in the station control room so that the operator can determine at a glance whether or not each unit is operating at maximum efficiency without having to refer to complicated curves and tabulations.

Under certain conditions considerable saving in losses may be effected by the use of generating units as synchronous condensers. This is the case when the number of units to be kept on the line, in order to maintain satisfactory voltage levels, is in excess of the minimum number required for power generation.

This type of operation introduces no difficulties where the turbine runner is set above the normal tailrace elevation and is common practice on the "Shawinigan" system. When used as a synchronous condenser, the unit operates on the bus with the turbine vanes closed and with the draft tube vented. The venting of the

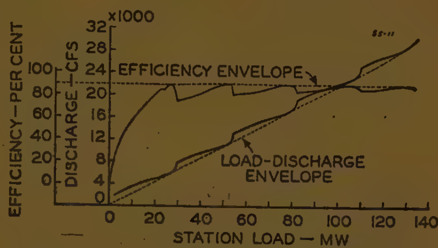

Figure 11. Station load versus discharge and efficiency, La Gabelle power house, 60 feet head

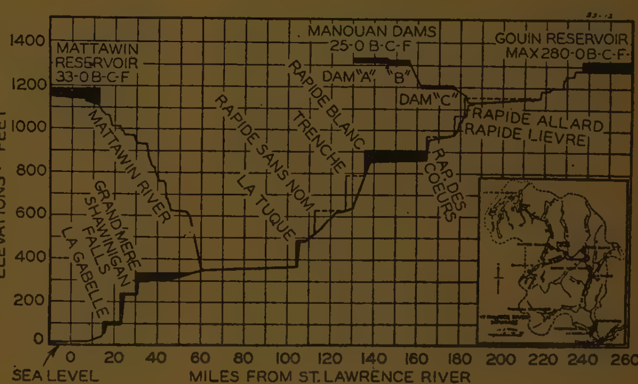

Figure 12. Diagrammatic profile of the St. Maurice River

draft tubes reduces the amount of power required to motor the unit. At Rapide Blanc, for example, a 33,000-kw unit requires approximately 3,500-kw to motor with the draft tube unvented, but only 1,000 kw when the draft tube is vented. These values of motoring power include the generator losses at full current.

At the La Gabelle generating station fixed-blade propeller-type runners are employed, and the runners are located below normal tailrace levels. In this particular case, when a spare unit is to be available for any appreciable length of time, the practice is to uncouple the turbine shaft and operate the generator by itself as a synchronous condenser. If this type of unit is operated as a condenser with its runner in water, the motoring power required is 21,000 kw or about 80 per cent of its capacity, which explains the practice of disconnecting the runner.

MAGNITUDE OF LOSSES IN ACTUAL PRACTICE

The total losses in generation on a system of this nature, of course, will depend to some extent on the general load conditions which exist. If the system has to be operated close to its maximum capacity, then efficiencies must be expected which will be lower than those possible under more favorable conditions.

This can be shown by comparing the actual results obtained on the Shawinigan system during the last two winter periods.

By the winter of 1942–43 the power requirements of the war industries were almost at a peak, and, while increased generating capacity gradually was being made available, particularly in the Saguenay River area, the power situation was temporarily critical. In order that the maximum war effort could be maintained during this period, the use of the hydraulic reserves of the Shawinigan Water and Power Company was essential. To maintain the high values of total output, a reduction in efficiency of generation had to be accepted.

In the winter of 1943–44, while power demands were heavy, it was unnecessary to force the output of the generating station to such an extent, and more normal operating efficiencies could be maintained.

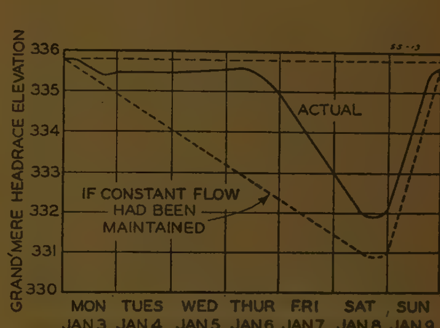

Figure 13. Weekly drawdown of Grand'-Mère headrace

Actual loss due to reduced head.....1.32 per cent
or 260,000 kilowatt-hours
With constant inflow loss would
have been.....................2.70 per cent
or 530,000 kilowatt-hours
Difference.....................1.38 per cent
or 270,000 kilowatt-hours

Table II shows a comparison between the weekly operating efficiencies during these two periods.

Table III gives a comparison between the efficiencies at the La Gabelle Station in the same two periods. The difference in efficiency is more noticeable here than in the case of the combined stations.

It must be kept in mind that reductions in generating efficiencies do not necessarily indicate poor operation. For example, if an appreciable increase in the uncontrollable flow of the river is anticipated, as the result of rain, the policy is to increase the generated output at certain stations and draw on the local pondages. Under these conditions, losses due to "low head," or even "improper loading," may be shown for a period, but these will be more than compensated for by the fact that water, which otherwise would be spilled over the dams, will be stored for future use.

There are obviously many factors, other than the efficiency of generation of individual stations, which must be considered if a true picture of over-all conditions is to be obtained. Nevertheless, experience in operating this particular hydroelectric system, where a change of one tenth of one per cent in efficiency of generation represents 5,000,000 kilowatt-hours per year, has indicated that the careful testing of each unit and the setting up of an accounting system as described herein will give adequate returns.

Electric Power in Aircraft

MABEL MACFERRAN ROCKWELL
MEMBER AIEE

Problems involved in extending the use of electric power in aircraft, possible applications of electricity in various types of airplanes, and the development work and equipment needed for these applications form the subject of this article. Not rivalry, but co-operation should exist between electric power and mechanical and hydraulic power in airplane applications, declares the author.

AT THE PRESENT time there is a very fine opportunity for the application of real engineering skill in the extension of the use of electric power in airplanes. Until very recent years airplanes in general have been relatively small and uncomplicated. Control operations could be accomplished readily by direct mechanical means, and such simple electrical functions as came to hand were taken care of adequately by low-voltage battery-magneto systems analogous to those used in automobiles. However, with the very large and very fast airplanes now being developed, problems arise for which electricity presents many interesting possibilities.

At the very outset it should be made clear that there ought not to be any violent rivalry between electric power on the one hand, and mechanical–hydraulic power on the other. Instead, we should recognize that there are many functions for which hydraulic and mechanical power are very well suited, and it is our job as engineers to find the best way to make electricity *co-operate* with other types of power to accomplish the best over-all result. In other words, it is a matter of developing teamwork. We as engineers have the responsibility of soberly balancing all the factors and determining where on the team each element functions best. Of course, as electrical engineers we may tend to believe that electric power is suited ideally to the quarterback position; but, on the other hand, we cannot afford to forget that hydraulic power has a lot of beef and speed and hence cannot be overlooked for the fullback job. In some cases, maybe electricity should call the signals, and hydraulic power should carry the ball over the goal line. However, it also should be quite possible to hand electricity the ball now and then and let it make a few end runs on its own.

In the present article the following topics will be discussed:

1. Possible applications of electric power in various kinds of airplanes.
2. Problems involved in such applications.
3. Development work and equipment needed for successful solution of these problems.
4. Engineering comparison of electric with other kinds of power in the various applications.

POSSIBLE APPLICATIONS IN VARIOUS TYPES OF AIRPLANES

The most significant types of airplane for present and future development are the large long-range transport, the superspeed military aircraft, and the small utility plane for local service and commuting. From the electrical standpoint the large long-range transport offers the most interesting possibilities and will be discussed first.

In these large airplanes now being developed certain uses of electricity are taken for granted. There is illumination, heating, cooking, air conditioning, small devices and gadgets of various sorts, and drives for water and oil pumps.

Another well-established electrical application lies in the essential field of radio communication, now augmented by the convenient interphone system within the airplane.

The next group of applications has to do with *operating* the airplane. Starting the engines is one very important job that electricity is called upon to do; while adjusting the pitch of the propeller blades for maximum efficiency at all times is another. Raising and lowering the landing gear is a vital function which can be well performed by electricity, but unfortunately some "false starts" in the early days more or less retarded confidence in the electric gear and left most designers favoring hydraulic operation for the time being. However, there is now a definite trend toward use of electrically operated landing gear.

A field in which electricity is just dabbling its toes, so to speak, is that of *control* of the airplane. So far, this has been a field pretty well monopolized by mechanical and hydraulic devices. However, propeller pitch controls are electrical, and much interest is being shown in remote-positioning devices for engine controls and secondary flight controls such as tabs and flaps. The greatest challenge is offered by the primary flight controls (rudder, elevators, ailerons) where mechanical and hydraulic operation are still strongly entrenched.

Finally, there is a large field for miscellaneous ingenious electrical applications such as deicing of wings, defrosting of windshields, safety interlocks, and all sorts of horns, sirens, and warning devices.

Essential substance of a conference paper presented at the AIEE Los Angeles technical meeting, Los Angeles, Calif., August 30, 1944.

Mabel Macferran Rockwell is research engineer with Lockheed Aircraft Corporation, Burbank, Calif.

Coming now to the field of military airplanes, not much can be said on this subject at present except to point out that many of the electrical applications already noted are obviously needed also in this type of airplane. A superspeed highly maneuverable airplane obviously requires hair-trigger control of great precision. Since it is well known that electricity provides excellent means for obtaining such control, whether it be in a steel mill or a watch factory, it stands to reason that here is an excellent field for electrical applications if only we can develop enough ingenuity on the design end. Furthermore, the possibility of using a network system for transmitting electric energy affords considerable improvement in reliability, as against the hazards of enemy bullets.

In the small postwar utility airplane, applications will not be so spectacular as those already described, but the possibilities are none the less interesting. Many of the ideas developed for the large airplanes doubtless will find application in the smaller ones. Especially there would seem to be a good field for electricity in windshield defrosting, communications, passenger-comfort features, and remote control of various operating functions.

PROBLEMS INVOLVED IN THE SUGGESTED APPLICATIONS

Some of the applications are relatively simple from the electrical standpoint. So far as lighting, heating, cooking, and miscellaneous devices are concerned, the chief requirements are adequate generating and distribution capacity, proper voltage maintenance, proper protection, and adequate reliability for the *essential* portions of the load such as navigation and cockpit lights and radio. These are all problems of "system engineering" and sound rather routine from the standpoint of ordinary commercial power engineering; but when thought of from the standpoint of aircraft applications, the achievement of these objectives is by no means as simple as it sounds. For example, we have as yet no satisfactory means of paralleling a-c alternators on the variable-speed aircraft engines; no lightweight aircraft-type induction relays; no satisfactory sources of standby power other than a battery, which is not of much help if an a-c system is used. Hence, the subject of correct system design even for the elementary applications already listed is not a matter to be dismissed lightly, and deserves more attention than it has received. More will be said on this subject in a later section.

We now proceed to a group of possible applications where there is plenty of room for ingenuity in developing the actual devices themselves. This would include all sorts of defrosting and deicing methods, warning signals, safety devices, and remote-positioning controls for engine, propeller, and so forth. The use of the Selsyn principle for such remote-control devices is now being studied, but apparently nothing much as yet has been done in regard to applying supervisory control with telephone-type relays. The latter is a field which presents most interesting untouched possibilities.

The next group of problems has to do with aircraft motors and involves quite a field for competent electrical design engineering. To begin with, there are the relatively large motors (large, that is, compared to the size of the aircraft generators) used for starters, blowers, pumps, and electric screw-jack actuators. Here very careful thought should be given to the question of whether specially designed windings to limit starting inrush should be utilized, to avoid undue "flicker" on the rest of the system. In the case of very large motors starting under heavy load, such as starters for the large airplane engines of the future, the special winding may be necessary in order to get the motor to start at all. The seriousness of this problem may be minimized by proper segregation of busses to isolate large motors from fluorescent lights and sensitive instruments; or by provision of a relatively large and stable power source as by the use of high-speed excitation on the generators or by paralleling generators. Here again, the importance of studying the *system* aspects of the problem is shown clearly. Especially is this true in the case of the engine-starter problem, which may prove acute.

At the other extreme the fractional-horsepower motors offer a field which has scarcely been touched—at least for a-c systems. A small light rugged motor with self-contained protection will fill a wide diversity of needs.

The last group of applications to be considered is the newest and most difficult—namely, that of airplane *controls*. In this field mechanical and hydraulic methods have been firmly entrenched, and electrical methods are only beginning to enter. As an example, the landing gear represents a vital operating portion of the airplane. A few early attempts at electrical operation did not arouse a great deal of enthusiasm, and hydraulic operation has been greatly in favor. However, a trend toward electrical operation has again developed recently and should probably be more widely accepted this time, since the use of motor-driven ball-nut screw actuators has made available a very efficient unit.

Developments are also under way in electrical operation of what may be called the "secondary" flight controls—tabs, flaps, and so forth. The need here is for a rugged fast-acting actuator, either electric or electrohydraulic.

When it comes to the main flight controls, by which is meant the rudder, elevators and ailerons, mechanical and hydraulic methods are very firmly entrenched—perhaps because they "got there fustest with the mostest," as the general said in explaining a military victory. The main flight controls in large airplanes involve two important requirements—there must be multiplication of the pilot's power and *range of motion*, and there must be "feel-back"—that is, the pilot insists on feeling the *reaction* of the surfaces to the force he exerts on the control stick and rudder pedals. Perhaps some day we shall train a new generation of pilots who are willing to fly an airplane by pushing buttons; but right now such a system cannot be sold. The power multiplication is easy for electricity to achieve; but, the "feel-back" is not.

To approach the problem of introducing electric power into the main airplane control system will require engineering skill of the highest order, because it will be necessary to begin with a thorough understanding of the load characteristics of the control surfaces, based on aerodynamic studies. It will then be necessary to determine how electric power can be made to accomplish the desired results and to integrate the electrical with the mechanical control features. It is quite possible that best results will be obtained by a combination of electric and hydraulic power, since hydraulic actuators are notably light in weight for a given thrust.

There is already a decided trend toward electric transmission of power to each actuator unit, the motor and pump being mounted close to or integrally with the hydraulic cylinder. Such a plan, compared with one in which pumps are located on the main airplane engines and hydraulic fluid is transmitted at high pressure throughout the airplane, can be shown to save considerable weight by the elimination of piping and excess hydraulic fluid. In a large airplane, an adequate electric distribution system is provided throughout the airplane for other electrical applications anyway, and the incremental weight introduced into such a system by "heavying up" for the control loads is not very great. In addition, with such a scheme of electric transmission to localized actuator units, a high degree of reliability is offered, since alternate busses, emergency throw-overs, or networks can be provided so that in the event of failure of one or two engines the essential electric system remains energized and all electric-driven actuators function as before. This is in contrast with the central hydraulic system, wherein if one or more engines fail the pumps mounted thereon are out of service, so that duplicate capacity (and weight) has to be provided in the other engine-driven pumps. Elimination of service and maintenance difficulties from leaks and freedom from troubles arising from low-temperature operation are additional advantages of the electric transmission system.

DEVELOPMENT WORK AND EQUIPMENT NEEDED

Analyzing the various discussed problems, it is found that those most needed are:

A. Electrohydraulic Actuating Units. These should be rugged, light in weight, and self-

contained. Ideally, two or three wires should go in one end, and a variable thrust should come out the other. There should be an adequate range of sizes and speeds of operation.

B. Variable-Speed Control for Actuating Units. To eliminate the necessity for hydraulic valves, it would be most helpful if a clever and rugged control system could be developed which would operate the electrical end of the electrohydraulic actuators at variable speeds and torques matching the aerodynamic requirements.

C. All-Electric Actuating Units. Same requirements as for *A*. Essential to have variable speed and torque control as in *B*.

D. Ingenious Remote-Control and Remote-Positioning Units. Using Selsyn or supervisory principles.

E. Well-Designed Large Motors. For high torque, low inrush.

F. Well-Designed Simple Fractional-Horsepower Motors.

G. Overcoming of Commutation Problems at High Altitude. The use of 110/220-volt d-c equipment offers many advantages if commutating problems under low-pressure conditions can be solved. Considerable progress has been reported in this field.

H. Improved Protective Devices for Aircraft Circuits. Lightweight induction and balanced relays, switches, and trip devices.

I. A Satisfactory Constant-Speed Drive for A-C Generators. Mechanical, hydraulic, or by means of separate turbines driven by exhaust gases.

J. Satisfactory Means of Paralleling A-C Generators. Depends on controllability of the constant-speed drive mentioned in *I*.

K. A Good Development Program on Auxiliary Power. How shall the radio be operated with all engines dead (emergency conditions)? How shall the first engine be started if the airplane has landed elsewhere than on a regular airfield with its local power supply for starters? Shall batteries be used? An auxiliary engine? What about size, weight, and cost?

L. A Careful Study of A-C Versus D-C Systems. There is great need for a careful evaluation of the merits of alternating versus direct current for large airplanes, based on a *well-engineered* system in each case. The a-c system offers the use of simple rugged induction motors and elimination of commutation problems; the d-c system offers flexible performance for control operations, ease of providing standby through batteries, and elimination of the need for a constant-speed generator drive. Weight considerations should be about equal for 110/220-volt direct current as against 120/208-volt alternating current.

M. Development of an All-Electric System of Flight Control. This is a distinctly "long-range" problem and would involve development of means for providing "feel-back" electrically.

N. Adequate "System-Engineering" Studies. A mental attitude should be developed whereby airplane electric systems are viewed *as a whole* rather than piecemeal. Analytical or even calculating-board studies should be made on airplane system problems, just as on commercial system problems. Subjects for such analyses are protection, network distribution, parallel operation, maximum load limit, voltage regulation, and behavior during transient starting conditions.

COMPARISON OF ELECTRIC WITH OTHER POWER SOURCES

It is necessary to admit that hydraulic power does certain things superlatively well, and that direct mechanical contrivances (pulleys and levers) give a very satisfactory sense of solidity and ruggedness. On the other hand, electric power has great flexibility, especially from the control standpoint. The most inviting field of application for electric power, at present, lies in the control and transmission of energy.

To substitute electric for hydraulic and mechanical power in large operating units will involve much careful study and ingenious development, and will only be warranted if advantages of weight or reliability can be shown to result. Before a correct comparison can be made, it probably will be necessary to engineer an all-electric airplane and compare it on an over-all basis with an all-hydraulic and mechanical airplane. It is hoped that in the postwar period, time will be found to approach this problem with adequate care and skill.

A Shipyard Public-Address System

W. ROSS AIKEN
ASSOCIATE AIEE

THE Richmond yard 2 of the Permanente Metal Corporation has been using a high-power public-address system for 24 months. With more than 2,000 paging calls each day, it has been highly successful. The calls are limited to those directly affecting production. Trucks, cranes, inspectors, and foremen are called to places in need of them. Much time is saved by reducing the time a crew of men has to wait for its work to pass inspection or to receive new orders. For example, the breakdown of a whirley crane means that all riggers, shipfitters, pipefitters, shipwrights, electricians, and welders must wait for needed material until the crane is repaired. As it requires specially trained electricians and mechanics, who may be scattered throughout the yard, to repair a breakdown, the public-address system is vitally important in locating these men.

This system differs from the average public-address system in that it covers a huge plant employing from 20,000 to 30,000 workers in an industry in which the noise level is extremely high. The system includes high-level paging and music channels. Although music is broadcast six times a day to entertain the workers and to aid in clearing the gates at the close of each shift, paging is the major function of this system.

The high-power public-address system described in this article covers a shipyard employing from 20,000 to 30,000 workers and includes plant protection, paging, launching, and music. Problems encountered in setting up and administering the system are analyzed.

There are five operating stations, and a system of importance rating is used, the entire operation being fully automatic. Each operating station is assigned a rating whereby it can take control of desired parts of the yard above other stations with lower ratings.

The ratings are:

1. Plant protection.
2. General paging.
3. Launching.
4. Local paging.
5. Music.

Numbers 2 and 3 are interchangeable, as some launching and special-events programs are more important than others.

The system consists of individual booster amplifiers, totaling several thousand watts.

Essential substance of a conference paper presented at the AIEE Los Angeles technical meeting, Los Angeles, Calif., August 29–September 1, 1944.

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It is operated remotely through an automatic-relay board and is operated during blackouts.

The yard is divided into more than 40 areas, each of which is served by one or more amplifiers and the necessary loud-speakers. All stations have switches and indicator lights for each area in which the station is interested. Simultaneous broadcasting in different areas from various stations is an integral part of this system.

Two initial problems are encountered in designing and installing a system of this type. The first, after the area to be covered has been decided upon, is the amount of power required. The second is the number and location of loud-speakers required to distribute this power. The first depends upon the extent and noisiness of the area.

Noise levels well above 100 decibels have been found in restricted locations in the yard. It is not practical to cause the audio output to approach this noise level, as this would mean the spreading of this level to most of the area covered by the loud-speakers with the attendant bad effect on the ears and nerves of the workers in that area. Therefore, a compromise volume is used which has proved effective.

The number of loud-speakers used depends upon the amount of power needed and upon the nature of the area. The presence of many buildings or obstructions, high prevailing winds, and large areas with little noise (the last because of blasting caused by high volume concentrated in a beam), all require a large number of loud-speakers, possibly with very little power in each.

In the shipyard traveling cranes limit the setting of poles so that there are few places where loud-speakers can be mounted. Therefore, it has been necessary to locate loud-speakers at the head of each shipway on existing lighting poles (Figure 1, part *A*). This means that an area 300 feet long must be covered with each loud-speaker group. This area is the noisiest in the yard. However, the situation is not so black as that statement would suggest, since the highest noise level is closest to the head of the way, as shown graphically in Figure 1, curve *B*. The voice distribution alone is shown in Figure 1, curve *C*, which is also loudest near the head of the way. Therefore, the loud-speakers at the head of the ways can be driven at a high-power level, and a distribution curve can be obtained which, relative to the noise level, is flat enough to insure good results over the entire area (Figure 1, curve *C*). Were it not for this type of noise distribution, this nearly flat curve would not be possible without extremely high poles, or blasting would occur. This does not apply to quiet periods when a different volume level is used, or to areas between the ways.

With the location of the loud-speakers comes the problem of setting the direction of these speakers. This is extremely important, as the usefulness of a system can be destroyed by an uncontrolled echo. An "echo" also can be noticed by one who hears two loud-speakers, one of which is located at a greater distance from the listener than the other. Figure 2 shows a trouble area adjacent to a building, caused by an echo from the walls. This echo cannot be heard within 55 feet of the wall, as the ear fails to detect the time lag. However, beyond 55 feet, the echo is distinguishable, but ceases to be troublesome about 125 feet from the wall, because of the relative difference in the level of incident and reflected wave.

The solution, then, is so to direct the loud-speakers that the concentrated power in the beam of the loud-speaker does not strike the wall directly, but at some intermediate point between the building and the way. The loud-speaker must not be "angled" out too much, as it might then cause an echo in areas covered by other loud-speakers.

Figure 1, curve *D* shows the relative distribution of the yard noise level during change of shift. As can be seen, it differs

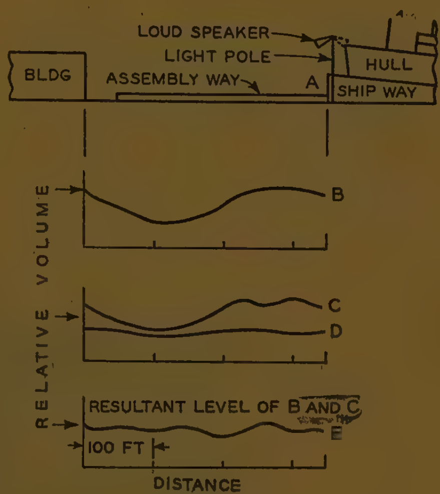

Figure 1

materially from the noise level during working hours (Figure 1, curve *B*). The principle illustrated in Figure 1, curve *E* hardly applies. Therefore, the level used for music is about ten decibels lower than that used for paging.

Although the amplifying equipment in the yard is of the high-fidelity type, that is, essentially flat from 50 to 10,000 cycles per second, the projection horns used in the yard have a frequency response of 165 to 5,000 cycles per second.

Frequencies higher than 5,000 cycles per second are of little use in the yard because of extraneous yard noises, wind, and the like. Bass frequencies below 165 cycles per second are eliminated because much of the power of the human voice is in this region and does not contribute to the intelligibility of speech.

The paging amplifiers are so designed that they do not reproduce needless bass frequencies to prevent overloading of the loud-speaker driver units.

When the paging was first started an amplifier was used that compressed the signal three decibels on peaks, thus doubling the average power of the system by allowing the amplifiers to be turned up three decibels without overloading.

However, the paging announcer forgot to watch the volume-indicator instrument and overrode the limit set for him. The power increase was tremendous. Residents of Richmond who lived as much as five miles distant called up at night to tell us to please turn off that "— thing, so we can get some sleep." The prevailing winds there blow toward Richmond.

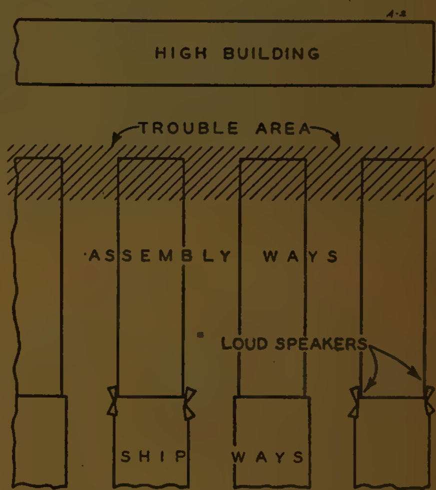

Figure 2. Trouble area adjacent to building caused by an echo from walls

The human voice, in pronouncing words, creates sounds which have peaks many times the average loudness. The volume must be loud enough so that the softest word or syllable can be heard distinctly over all the area covered. Therefore, the peaks are louder than necessary and serve only to cause echoes and disturb sleepers.

A peak-limiting system has been built into the preamplifiers which comes into operation suddenly at a given volume level and actually restricts the output, within close limits, to a predetermined level. It is no longer necessary to worry about talking not too loudly, not too softly, for one can do nothing about it. The output volume is maintained constant, regardless of the strength of the speaker's voice.

A unique system of indicating lights is used on the switchboards. Each loud-speaker group is controlled by a three-position lever switch, above which are two pilot lights, one green and the other red. The green lights indicate which

Figure 3. View of main check gate

Location of loud-speaker is in circle. Officer with microphone is in upper right-hand corner

a circle shows the location of the loud-speakers covering this area.

Besides the microphone having ultimate control over the yard, the plant-protection setup in this yard includes local microphones and intercommunication devices, a high tower with directional loud-speaking equipment for directing automobile traffic in the parking lot, and a receiver and transmitter which are tuned to the frequency of the Richmond police radio.

There is portable equipment to be used during launchings, including amplifiers for local loud-speakers on the launching platform. A channel automatically connects the launching equipment to the rest of the yard and to the recording apparatus. The launching apparatus is set up in a few moments, as everything is made to plug into receptacles already mounted. Besides the loud-speakers in the yard, there are loud-speakers located on the launching platform and also one at the trigger. In this way the launching crew knows how the ceremonies are progressing, so that they may have everything correctly timed. Important ceremonies and speeches are recorded. This equipment can be operated from any shipway or dock in the yard.

station has control of a group of loud-speakers. Thus, the paging announcer is not apt to waste his breath and time talking to shipway 5 when a launching program has priority on that way. When the amplifiers for an area are on, red lights at all control stations interested in that area are lit. If either the plate or the filament fuse should blow, the power fail for any reason, or the output tubes fail, those lights would go out. This provision facilitates maintenance and paid special dividends when the power company had trouble and the line voltage rose more than 50 per cent. No damage was done to amplifiers as fuses, automatic controls, and so on, were sufficient protection, but this occurred during a program and the light system enabled the operators to know at once which sets could be put back on the line when the voltage was normal again.

The three-position remote-control switches allow quick selection of mixed areas. The up position is "on," the middle is "master circuit," the lower is "off." No power is on unless the grip-to-talk "mike" handle or equivalent switch is closed. Switches are normally in the "master" position. If one area only is wanted, that switch is turned up; if all are wanted, the master is turned up; if all but one are wanted, that one is turned down. Several area masters are also provided.

All switching is done at low level (zero decibels), using d-c relays. Automatic action is obtained through the use of electrical interlocks.

The music control room has two control boards, one for the inside studio, the mixer of which has three microphone channels, three phonograph channels, and two radio channels (one high-fidelity broadcast band; the other short-wave). The control board for the outside stage has one phonograph and three microphone channels.

There is also a complete transcription-recording apparatus, which is used often. Entertainment programs are put on during lunch hours, and march records are played at each change of shift. These programs have been found to be effective in morale building. The use of the public-address system during change of shifts has been found to clear the gates about 53 per cent sooner than would otherwise be the case. The yard police department reports that, since the public-address system has been in use, 10,000 workers clear the check gates in nine minutes instead of 17 minutes, and that a substantial reduction in the number of accidents has been effected. In Figure 3

The yard is crisscrossed with a network of interoffice-communication loud-speaking units, three types of which have been developed to meet particular problems associated with this type of plant. High noise level, bad electrical interference, and so forth, have all produced problems in regard to electrical communications.

It is extremely difficult to evaluate such intangibles as future time and materials saved through the use of this system, as well as immediate man-hours saved by lessening the time crews must wait for leaders, materials, repairs, and so on.

A conservative estimate of messenger time saved during the past 24 months amounts to more than 404,912 man-hours, and an estimated saving in production of 907,056 man-hours to date can be accredited to the public-address system.

Figure 4. Studio control panel and remote switches

Application of Statistics to Dielectrics

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The application of statistics to insulations poses three important engineering problems which according to these authors have not been given the consideration they deserve: (1) establishing a specification for a material which adequately defines its characteristics; (2) formulating a method of evaluating the material to assure both supplier and user that the material meets the specifications; and (3) translating the material specifications into design practice. In this article solutions to these problems are outlined.

THE INSULATION FIELD is well supplied with a very large variety of materials. When these materials are used in large quantities, such as slot insulation in a motor, the uniformity of the material over a long period of time is essential. This uniformity is assured only by the adequacy of the specification and the faithfulness of the manufacture, the inspection, and the test.

Let us consider the properties of a certain kind of paper used as an electrical insulation. In the past the specifications usually have called for some average dielectric strength, sometimes with an allowable percentage variation. This is a very weak specification, because it does not clarify the meaning of an allowable variation. If this is interpreted as a permissible variation in the average, then we must expect individual dielectric tests to deviate considerably more than this amount. It is well known that, if dielectric tests are made on a large number of samples, failures will occur over a range of voltages. Figure 1A is a bar graph of the dielectric strength representing 150 tests on a paper 15 mils thick. This graph is obtained by plotting as ordinates the number of test failures that occur in ten-volt class intervals expressed in volts per mil. This shows a considerable spread in failure voltage. Fortunately, there are numerical methods of expressing this spread in terms of units of the abscissa, namely: standard deviation and range.

Determining the range involves a single computation, that is, subtracting the minimum readings from the maximum readings found in the sample involved. On the other hand, the standard deviation is calculated by squaring all of the individual deviations, adding the squares, dividing by the total number of deviations, and taking the square root of the quotient. The standard deviation for the data expressed in Figure 1A is 32.2 volts per mil, whereas the grand average is 542 volts per mil. Physically this means that about 99.7 per cent of all the test data normally would fall within a distance of three standard deviations on each side of the mean, that is from 445 to 638 volts per mil.

A theoretical normal curve can be drawn as in Figure 1B to represent facts shown by the bar graph. The peak of the curve will correspond to the grand average. Its extremities for practical purposes extend to plus and minus three standard deviations from the mean. This normal curve is defined accurately by specifying the mean and the standard deviation. Thus, the average of 542 volts per mil and a standard deviation of 32.2 volts per mil define the dielectric characteristics of the 15-mil paper under some qualifying test conditions. As long as these two values remain the same, the uniformity of the material may be assumed to remain constant.

During the present emergency, the engineer often is required to use substitute materials. It is very difficult to select the proper substitute if only average values for the characteristics are known. However, the type of information supplied by statistical analysis permits the most fundamental comparison of materials of any method available. Suppose, for example, that a second material has a mean dielectric strength of 575 volts per mil and has a standard deviation of 75 volts per mil. Judging from the average values alone, one would be forced to conclude that the material having the higher value would be the better material. The distribution curve for the second material is superimposed in Figure 2 over the curve of the original material in order to show more clearly the effect of the standard deviation. It is very doubtful now if the second material is better than the first. In fact, if both materials were subjected to 475 volts per mil, nine per cent of the second material would fail whereas only 1.8 per cent of the first material would be rejected.

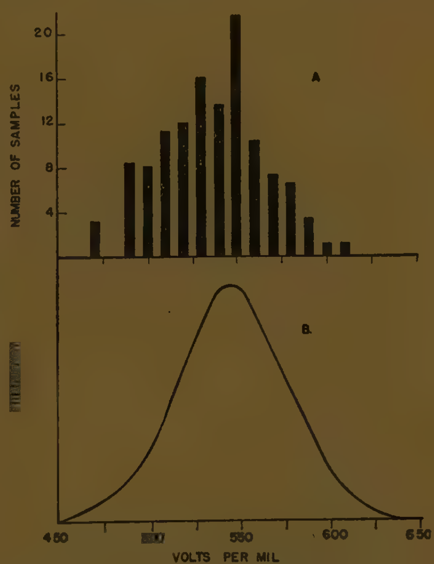

Figure 1. Frequency distribution of dielectric strength of 15-mil paper

A—Bar graph representing tests on 150 samples
B—Theoretical curve representing data in A

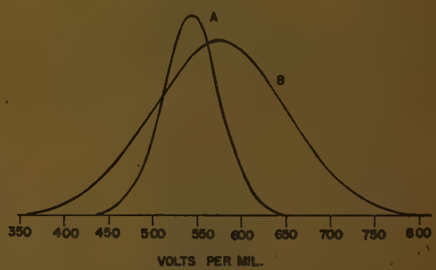

Figure 2. Comparison of dielectric strength of two materials

A—Mean 542 volts per mil. Standard deviation 32.2 volts per mil

B—Mean 575 volts per mil. Standard deviation 75 volts per mil

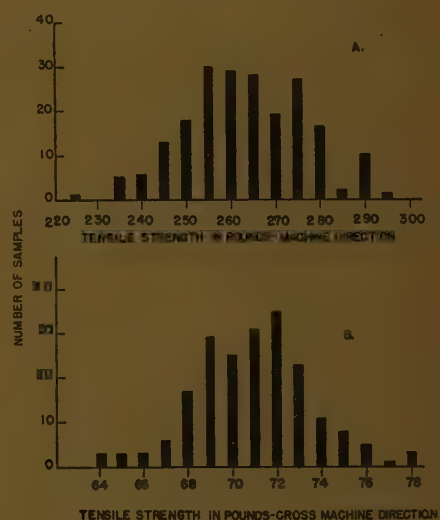

Figure 3. Frequency distribution of tensile strength of 15-mil paper

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Essential substance of a conference paper presented at the AIEE summer technical meeting, St. Louis, Mo., June 26–30, 1944.

C. M. Summers and K. E. Ross are both with General Electric Company, Fort Wayne, Ind.

The two materials illustrated are not equivalent. Substitution of the second material would have resulted in a poorer product, or at least one having a greater number of rejections, if an engineering limit of 475 volts per mil had to be met. The value of the statistical specification, therefore, is very real, as a means not only of defining the required quality of the raw

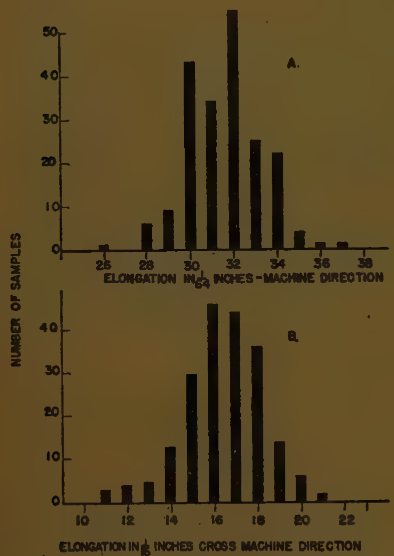


Figure 4. Frequency distribution of elongation of 15-mil paper

material, but also of selecting substitute materials.

The mechanical properties of the paper can be represented likewise in statistical terms. The tensile strength, elongation, and tear resistance of the paper are represented in Figures 3, 4, and 5. To each of these curves a mean and a standard deviation can be assigned which define the respective properties of the material. Thus when the variation due to sample size is excluded, the complete characteristics for the paper considered are as given in Table I.

Naturally, the test conditions must be qualified. Such items as temperature and humidity and test electrodes must be designated for the dielectric tests, but most of these conditions have been treated by the American Society for Testing Materials and will not be given further attention here.

There is another important factor that should be considered in making a specification: that is, to specify the most significant properties. For example, tensile strength and tear resistance are important for a material to be used as a slot insulator for a motor, because the material is subject to these mechanical actions during the manufacturing process. The same mechanical properties would not be important in a layer insulation, but other properties would be specified significant of the results expected of the material.

Table I. Characteristics of the Paper

	Mean	Standard Deviation
Dielectric strength	542.0	32.0
Tensile strength *MD**	263.0	13.0
Tensile strength *CMD**	71.0	2.8
Elongation *MD*	0.5	0.028
Elongation *CMD*	1.02	0.12
Tear resistance *MD*	48.2	2.2
Tear resistance *CMD*	81.9	2.9

* *MD*—Machine direction. *CMD*—Cross machine direction.

EVALUATION OF MATERIAL

After the specification has been established, there must be a common basis upon which both the supplier and user can sample and test the material to determine

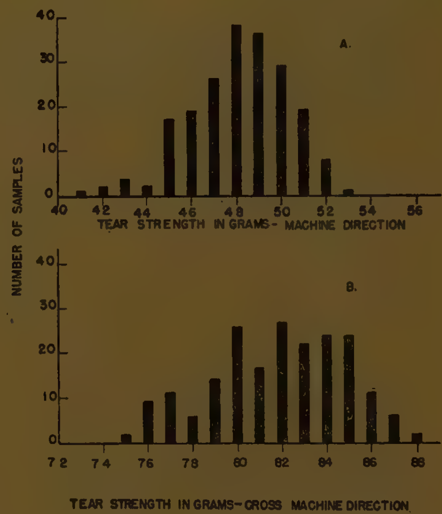


Figure 5. Frequency distribution of tear strength of 15-mil paper

its conformance with the specification. The method of such selecting and testing of the sample may be defined clearly in the specification. The selection of the samples, the type of tests to be made and the qualifying conditions affecting the tests, and the limits of the properties obtained from the tests should be covered.

All sampling systems involve a risk to both the user and the supplier. The user must take a certain risk of accepting a lot of material below the specification, and the supplier must take a risk of having an acceptable lot rejected. In general, the larger the sample size, the smaller the risk.

If the tests destroy the sample, then the sample size is greatly affected by the economics associated with the sample and the time required to test it. The sample size not only affects the risk, but directly governs the limits that must be set up for accepting the material.

The properties of a material have been defined by the mean and standard deviation. If a number of small samples are treated individually, we may expect both the mean and standard deviation to vary within the limits established by the sample size and still be acceptable. Accordingly, the acceptance chart based on a sample size of 25 is shown in Figure 6 for dielectric strength of the paper represented in Figure 1. As long as the mean and standard deviation lie within the limit lines, the sample is acceptable. In similar manner, the limit lines can be set for all other qualities based on a statistical specification.

TRANSITION TO ENGINEERING PRACTICE

Even when the engineer has all of the available data on a material, he seldom can incorporate this information directly into design practice. The engineer must modify the known characteristics by factors of safety, in order to compensate for the many factors that influence a material from its raw state to the finished product. Mechanical treatment, moisture absorption, subjection to high temperatures, and many other factors are encountered in the manufacturing processes which may alter the characteristics of the insulation, so that the original properties defined by the specification are invalidated.

The finished product practically never

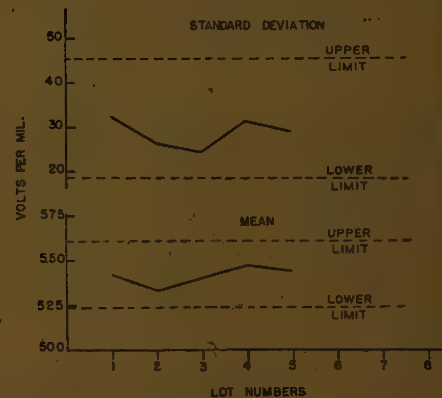


Figure 6. Control limits of standard deviation and mean values of dielectric strength of 15-mil paper based on a sample size of 25 units

operates under the same conditions of time, temperature, and voltage stress as those established by the material specification. Even the thickness of the insulation may be different, and the size and shape of the equivalent electrodes are radically different in the finished product.

The engineer must rely upon past experience to guide him in introducing factors of safety to offset all of these adverse conditions. While many of the factors may defy all types of analysis, some of them can be analyzed statistically in a manner that will provide the engineer with some very valuable data. For example, the effect of time and temperature on the dielectric properties of an insulation is suitable for statistical study.

OPERATING CONDITIONS

It is well known that the dielectric strength of most materials decreases as the voltage stress is applied for longer and longer periods of time. In fact the con-

tinuous dielectric strength of some varnished cloths may be as low as one third of the short-time strength. The general shape of the mean time–dielectric-strength curve appears as curve B in Figure 7.

This curve is obtained by applying several values of voltage, less than the instantaneous breakdown strength, and holding each voltage until failure occurs. Naturally, if a large number of samples are used, they will not fail in the same length of time; hence a time–frequency-distribution curve can be obtained for each value of voltage. This is represented by G in Figure 7. If the material has a statistical specification, the short-time dielectric-strength–distribution curve similar to Figure 1 will be available and is represented in Figure 7 by F. A curve then can be drawn through each extremity of the various distribution curves A and C and another curve through their means. Then we should never expect to find any failures at any voltage in a time less than that defined by curve C. If the equipment must

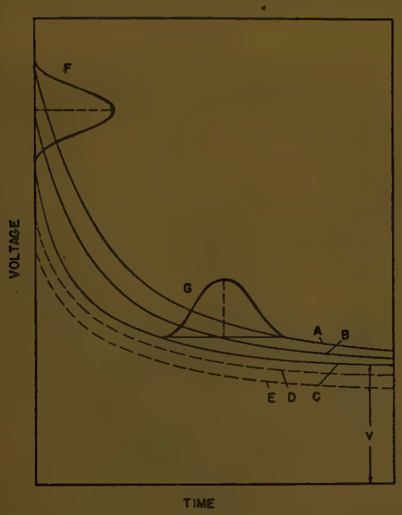


Figure 7. General frequency distribution of time life characteristics of an insulation material

A–B–C—Curves drawn through the mean and extremities of several frequency-distribution curves similar to G and F
D—Design-objective curve
E—Test-objective curve

operate continuously in service, the engineer can establish a value of V volts per mil as a maximum value to use in design practice.

The curves shown in Figure 7 apply at only one temperature and humidity. To

Table II

Voltage	Time	Temperature
V_1	x_1	$T1$
V_1	x_3	$T2$
V_1	x_4	$T3$
V_2	x_2	$T1$
V_2	x_4	$T2$
V_3	x_4	$T1$

make the story more complete, therefore, there should be a series of similar curves representing a range of operating temperatures and humidities. Naturally, a lot of time and effort is required to secure the mass of data required. If these curves could be established, however, a design-objective curve (E in Figure 7) could be set up on a more fundamental basis than at present. No doubt, there would be other factors, such as mechanical abuse, that would have to be represented in the design-objective curve, and perhaps these could be evaluated in some manner. If not, the engineer still would have to rely on past experience to locate the design-objective curve. However, the more items that can be evaluated accurately, the less

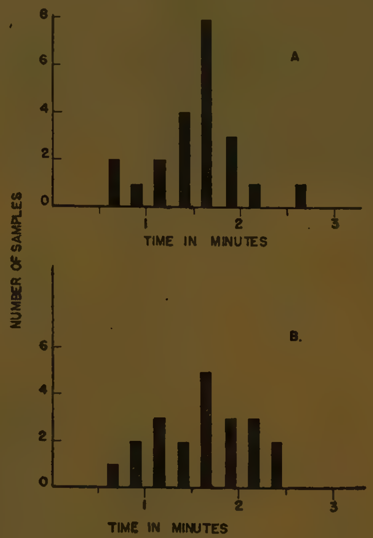


Figure 8. Time distribution of dielectric failure of a molded part

A—Tests at 14,000 volts and 125 degrees centigrade
B—Tests at 18,000 volts and 115 degrees centigrade

becomes the importance of errors in judgment applied to the factors which cannot be analyzed.

TEST OBJECTIVE

In addition to the design-objective curve, a test-objective curve can be recommended, such as D in Figure 7. In testing the insulation system, any applied voltage and corresponding time along this curve should produce a failure only in a defective unit. Quite often the question arises regarding the equivalence of a dielectric-test voltage when two time elements are involved. For example, if a ground-test voltage of 1,500 volts is applied to an insulation system for 30 seconds, what equivalent voltage should be applied for one minute? A test-objective curve as in Figure 7 should provide the answer, and this hypothesis is substantiated partially by experience with a molded part, where temperature as well as time had to be considered. This part was originally tested at 125 degrees centigrade at 14,000 volts for 30 seconds. Later it became necessary to reduce the temperature to 115 degrees centigrade. The problem was to determine a test voltage and a time of application which would guarantee the same product quality under the new conditions. A time–distribution curve was taken on a number of samples at 125 degrees centigrade by applying 14,000 volts until failure occurred. The results are shown also in Figure 8A. Then the temperature was reduced to 115 degrees and the voltage raised until a time–distribution curve was obtained similar to the original. It was found that a test voltage of 18,000 volts

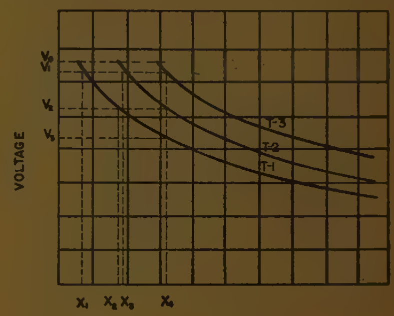


Figure 9. Equivalent test conditions involving voltage, time, and temperature

produced this equivalence as shown in Figure 8B. Furthermore, the time of 30 seconds for the test produced about the same percentage of failures as the original test. The same voltage (14,000 volts) applied for a longer time at the lower temperature would have produced an equivalent test. This equivalence can be shown on the voltage–life curves in Figure 9. Each curve represents mean values of a large number of tests. If the deviation from the mean is of the same order, throughout the conditions represented, then the values given in Table II are essentially equivalent.

CONCLUSIONS

An attempt has been made in the foregoing discussion to point out the value of statistical methods in establishing a specification which adequately describes an insulation material. The control-chart method, based on an agreeable sample size, is suggested for determining whether or not the material adheres to the specification. A virgin field is represented in the transformation of the characteristics of a material into data suitable for design purposes. The statistical method provides a powerful tool for analyzing such properties as the effect of time and temperature on the properties of a material. The proper analysis of any material depends on the measurement of one or more of its characteristics. Thus, the value of the analysis depends on selecting the most significant property to measure. The ultimate aim would be to measure a quantity that would represent the performance of the material in the finished product.

New 147,000-Kw Unit at Fisk Station

OUTSTRIPPING in capacity any other turbogenerator placed in service in the United States since Pearl Harbor, the new 147,000-kw unit 17, shown in Figure 1, at Commonwealth Edison Company's historic Fisk station in Chicago, Ill., is now running under full load and playing an important role in the job of meeting the huge power demands of war-production industries. It embraces what is claimed to be the largest single-shaft turbine in the world operating at a steam pressure of 1,250 pounds per square inch and a temperature of 925 degrees Fahrenheit.

To provide space for the new machine, vertical units 8, 9, and 10 were removed. Room for the two steam generators and four feed pumps was afforded by removing the boilers originally installed for units 6, 7, and 8. Thus the new 147,000-kw installation was placed in a station area originally provided, in 1903, for 15,000 kw of capacity in units of the type shown in Figure 2. Actually it replaces obsolete units representing installed capacity of 36,000 kw as shown in Table I.

Two steam-generating units, each designed to provide 750,000 pounds of steam per hour at 1,325 pounds per square inch and 935 degrees Fahrenheit, are provided. They are of the Babcock and Wilcox high-head type, equipped with continuous-tube drainable superheaters, continuous-tube economizers, tubular air heaters, intertube-type attemperators, water-cooled furnace walls, and continuous-slag-tap furnaces.

Fuel fired in this installation is central Illinois coal, which has an ash content of approximately 14 per cent. Electric precipitators, one for each boiler unit, are located in the gas duct between the air heaters and induced draft fans. They collect 90 per cent of the fly ash borne by the gases before they discharge to the stack.

Four 600,000-pounds-per-hour 1,600-pounds-per-square-inch boiler feed pumps are provided for the installation. Three are driven by constant-speed 1,750-horsepower 3,570-rpm motors and one by a 1,540-horsepower 3,340-rpm turbine. Feed pressure is controlled manually from the motor-driven pumps by throttling the pump discharge valves. Control with the turbine-driven pump is attained by regulating its speed. Normally the turbine-driven pump is used as a spare.

The steam path of the 1,800-rpm Allis-Chalmers tandem-compound Curtis–reaction condensing turbine consists of a Curtis stage and 39 reaction stages. Blades in the last row of the double-flow low-pressure turbine have a tip speed of 1,135 feet per second. The throttle steam flow at full load is 1,262,000 pounds per hour, while the condenser flow is 845,300 pounds per hour. The difference of 416,700 pounds per hour is bled for feed water

Figure 1 (above). New unit 17 at Fisk station, Chicago, Ill.

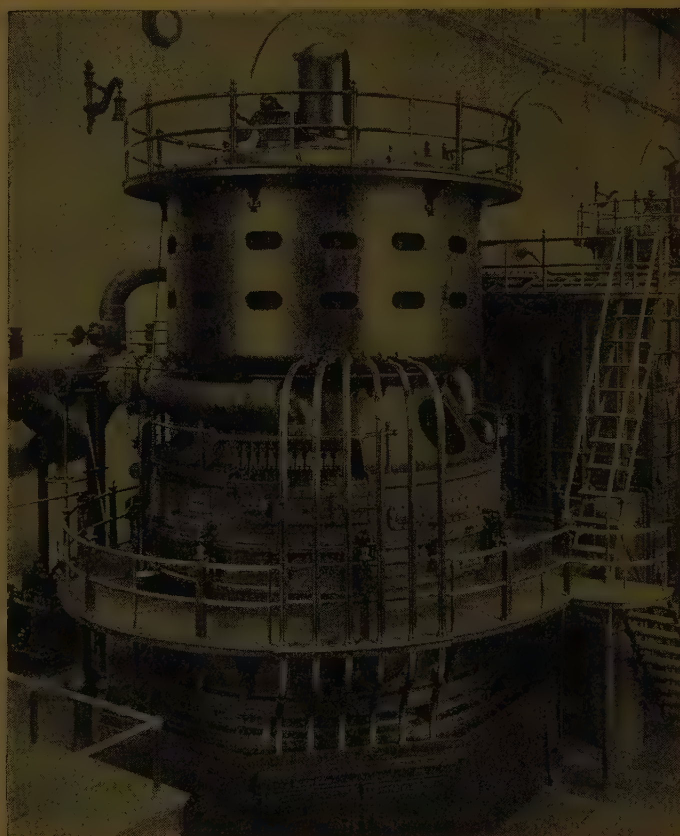


Figure 2. First turbine in Fisk station

"Amazingly large" was the phrase used to describe this pioneer 5,000-kw turbogenerator some 40 years ago when it was placed in operation

Table I. Fisk Station Installations

Unit	Capacity (Kw)	Service Date
Old No. 1	5,000	10- 2-03
Old No. 2	5,000	12-11-03
Old No. 3	5,000	4-21-04
Old No. 4	7,500	10-27-04
No. 5	12,000	9-17-06
No. 6	12,000	10-10-06
No. 7	12,000	11-13-06
No. 8	12,000	1-22-07
No. 9	12,000	7-19-07
No. 10	12,000	9-17-07
Replaced No. 4	12,000	5-21-09
Replaced No. 3	12,000	6-14-09
Replaced No. 2	12,000	9- 3-09
Replaced No. 1	12,000	10-28-09
No. 14	20,000	3-30-14
No. 11	25,000	6-21-14
No. 13	30,000	12-24-19
No. 12	35,000	1-18-20
No. 15	30,000	10- 8-37
No. 17	147,000	12-11-43

heating. In all, five bleed points are provided. Final feed water temperature of 455 degrees Fahrenheit is attained.

Because of the large amount of steam required, the turbine is provided with two steam chests, one on either side of the high-pressure cylinder. On each steam chest is mounted a 14-inch throttle valve and three 12-inch admission valves. An equalizing line connects the two steam chests to equalize flow at high loads. The blade-carrying portion of the high-pressure spindle is machined from a solid single forging. A stub end is shrunk, keyed, and bolted at the low-pressure end. The low-pressure spindle consists of a built-up welded assembly of forged-steel disks and two forged-steel shaft ends. This construction, unique in design, is used to insure a sound structure in the size of spindle involved.

The generator is a 147,000-kw 60-cycle 12,600-volt, three-phase air-cooled unit. It is designed for operation at 85 per cent power factor. Because of the machine's large capacity both in kilowatts and amperes, its armature has two electrically independent windings, each of which connects to a separate bus system. The terminals of the two windings are brought out on opposite ends of the armature to relieve congestion of cables under the machines as much as possible.

Because of the large size of the field, its core is built up of a forged steel shaft provided with axial serrated grooves into which teeth are fitted to form the sides of the coil slots and the center of the poles. This construction avoids the extremely large forging that would be required if one-piece construction were used as on smaller machines.

The turbine heat rate at full load is 8,750 Btu per kilowatt-hour gross. The auxiliary power at full load amounts to about 7,000 kw so that with a boiler room efficiency of 87 per cent the over-all net heat rate will be about 11,000 Btu per net kilowatt-hour.

With the addition of unit 17, Fisk—the first all-turbine station in the United States—marks another important milestone in power-generation development. This single machine, with its two steam generators, has more than twice the capacity of the 14 units and 112 boilers originally conceived for the station. When compared with the original units on the basis of floor area occupied the concentration of power is tenfold. Capacity per unit installed has been increased 30 times and performance has been improved 500 per cent.

Should There Be an Engineer in the President's Cabinet?

CREATION of the position of Engineer-Consultant in the President's Cabinet is urged by H. L. Fruend, water-control planning board, Tennessee Valley Authority, Knoxville, Tenn., in an article published in the September 1944 issue of *Civil Engineering* (pages 393–4). His plan is outlined in the following paragraphs, which are quoted from the article.

"The plan . . . is relatively simple. It calls for no great change in established governmental procedures. It recognizes the functions of existing agencies and bureaus. It seeks no definite control of anything. Its services are strictly advisory. It will encounter much opposition from powerful groups having their own schemes. But if adopted it eventually will punch the bottom out of the pork barrel.

"This suggested plan is to enlarge the President's cabinet to include a consulting engineer, whose position would be similar to that of the Attorney General and whose title would be Engineer-Consultant. The powers of the Engineer-Consultant would be solely those of technical adviser to the President. No Federal agencies, bureaus, or services would be assigned to his office or administered under his direction.

"The Engineer-Consultant, however, would have the power at any time to investigate the activities of any agency conducting or supervising engineering operations for the Federal Government and to submit a confidential report of his findings and recommendations to the President, but he would be under no obligation to do so except on presidential request.

"His regular duties would in no way interfere with his work as a consultant, and his primary duty would be to advise the President on the feasibility, need, and economy of all legislation and executive orders making provision for engineering services or involving the installation, operation, or administration of public works, or for conducting other engineering activities. In such capacity, his services as a consultant would be made available to congressional committees, Federal bureaus, and other national agencies when and if requested. As an official member of the Cabinet, the Engineer-Consultant would be appointed by the President and would hold office only at his will and discretion.

"To a large extent the staff would consist of recognized specialists in technical lines, whom the Engineer-Consultant might appoint either temporarily or permanently, and who would not be subject to Civil Service regulations. He would open such regional offices, either permanent or temporary, as might be required to conduct readily the duties of his office, and he would have the power to employ competent private engineering firms or professional engineers to conduct special studies or make a report.

"The Engineer-Consultant would maintain a register of all professional engineering firms and technical engineering experts qualified to practice before his office and registered in the state wherein the work is to be done, or the engineering operations carried on.

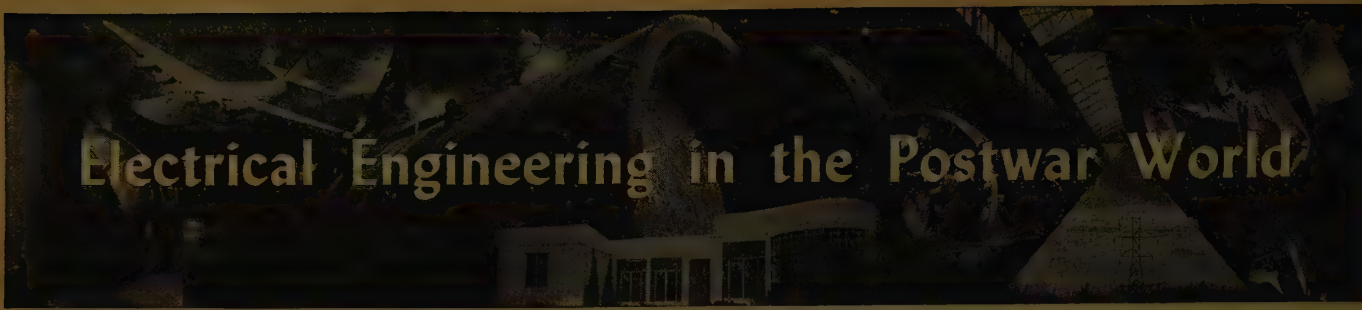
"To the maximum extent practicable, the consultant would select from this register an engineering firm or professional engineer of recognized ability and standing to conduct specific investigations or studies—one who, in general, would be cognizant of local needs and requirements. The compensation for this consultation would be in accordance with such uniform schedules of fees or per-diem rates for engineering services as might be adopted by the so-called national Founder Societies for the private practice of engineering.

"Unless otherwise required by law or executive order, the Engineer-Consultant would assign any authorized project involving the design, construction, operation, or maintenance of public works, or the rendering of regular and continuous engineering service, to the proper Federal engineering bureau or agency established for carrying on such work or related effort. The Engineer-Consultant would not carry on or supervise directly either the construction or the operation of any public project.

"The Engineer-Consultant would keep the President advised upon the proper co-ordination of all Federal engineering services to the extent of avoiding duplication and inefficiency, and he would have the power to effect the temporary transfer of engineering specialists and their staffs from one Federal agency to another in order to conduct related engineering operations of the Government more efficiently.

"However, he would have no power to direct or to interfere with the work of any Federal agency to the extent of impeding its regular operations or lowering its efficiency.

"The Engineer-Consultant would endeavor to maintain the highest degree of efficiency in all Federal engineering services and to co-operate with state and local authorities having a direct interest in any project. To this extent, his preliminary engineering studies and investigations would not be limited by claims of exclusive jurisdiction or regional control which might be held by any other department or body."



VII. Aircraft Electricity

T. B. HOLLIDAY
MEMBER AIEE

World War II has taught designers of aircraft electric equipment many valuable lessons which will be applied to peacetime production to create more powerful, lighter-weight, and more efficient electric apparatus for aircraft and other fields.

WAR is an unprofitable enterprise. However, one of the brighter sides of war is that problems and their solutions which develop from military necessity become commercial advantages. In other words, wars make better things for peace. It is quite likely that the advances in electrical-engineering art which have resulted from aviation electricity will fall into this category.

Practically all of the outstanding progress in aviation electrical engineering is confined to a period of ten years. Shortly after the first World War, electric apparatus began to appear in aircraft. Aside from its application for the ignition system which was discarded in favor of the magneto, the first use was for aircraft lighting. This lighting was rather crude, since it consisted of wing tip and taillights, to mark the position of the airplane, plus cockpit lights, by means of which the instruments could be read. Use of this lighting equipment required a storage battery which was installed as needed for a night flight.

Since aircraft engines were becoming larger, the problem of starting them was becoming more difficult. Therefore, the next logical application was that of an engine starter. This required a larger battery, and, to avoid the problem of frequent replacement of the battery, a generator was installed to keep the latter charged. This simple lighting system and engine starter were the small beginning of a long list of electric apparatus which now appears in the modern airplane.

DEVELOPMENT OF GENERATORS

The development of generators which have been produced by the electrical industry is the most amazing of all and is the foundation for the wide usage of electric equipment. Some of the problems encountered by the engineers who developed generators must be understood in order to appreciate fully their accomplishment. For many years the generator has been restricted to a space on the accessory section of the engine having a maximum diameter of $6^1/_2$ inches. In many engines even this amount of space is not available. Regardless of the amount of power which was required by the electric system, the generator could not exceed this dimension.

The generator, which was standard equipment until as late as 1939, was six inches in diameter, weighed 32 pounds, and produced 750 watts (50 amperes at 15 volts) at a minimum speed of approximately 2,300 rpm. This generator weighed more than it should, because the voltage regulator used with it was the single-vibrating-contact type sometimes described as the Tirrill. In order to obtain satisfactory life of the contacts, field current had to be restricted to 1.5 amperes. The way for lighter generators was opened by the development of other types of voltage regulators. These types might be described as multicontact and carbon-pile types. With these, the field current could reach a maximum value of eight amperes. Use of the higher values of field currents permits working the magnetic sections of the generator to the maximum extent. This step cut the amount of iron to approximately half its former value with a corresponding reduction in the length of copper windings. As a result, it was possible to cut the weight of generators having the same rating practically in half.

The progress in this development is best shown by the downward trend of the specific weight of generators in terms of pounds per kilowatt. The generator previously mentioned, which weighed 32 pounds, has a specific weight of approximately 43 pounds per kilowatt. A six-kilowatt generator (30 volts at 200 amperes) which weighs 42 pounds, has a specific weight of seven pounds per kilowatt, approximately one-sixth that of its predecessor. By doubling the rated speed of the generator making the minimum speed approximately 4,400 rpm, it has been possible to obtain further reductions. At this writing, it appears that a 12-kw (30-volt 400-ampere) generator can be produced in a total weight of 50 pounds which will be a specific weight of slightly more than four pounds per kilowatt, less than one-tenth that of its predecessor. These accomplishments have been made without requiring any increase in space on the accessory section of the engine. It is one of the minor miracles of the war.

PROGRESS IN DESIGN OF D-C MOTORS

Corresponding progress in the design of d-c motors also is being made, but it is much slower. Better progress has been made in the design of intermittent-duty motors which are used for such applications as retraction of landing gear, operation of wing flaps, and engine cowl flaps.

The increase in electric loads is having the expected effect on electric systems. That which was used during the 1920's and 1930's was a 12–15-volt system in which the battery was the predominant element. The generator was installed merely to keep the battery charged. As the load increased, it was found that doubling the operating voltage to 24–30 volts would permit the use of approximately double the power rating with very little penalty in weight. For example, the 15-volt 50-ampere generator mentioned was changed to a 30-volt generator at an increase of only two pounds, making its total weight 34 pounds. The weight of wiring was reduced somewhat. Therefore, twice the power was made available at an actual saving in weight. As the rating of generators has increased, the importance of the battery has decreased until the generator is now the predominant element.

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The importance of the battery has decreased to such an extent that there has been a very active development for small engine-generator units which provide power on the ground and which are a substitute for batteries in aircraft. These auxiliary engines fill a gap in the engine line which will have wide application after the war. There have been many engines of the three-quarter- to three-horsepower rating built for commercial usage, and there have been many of much higher rating, but the intermediate class of 5 to 25 horsepower has been neglected. These auxiliary power plants fill this need with lightweight economical units which should have wide application for a variety of purposes. For example, one 15-horsepower unit weighs 85 pounds or seven pounds per horsepower, which is much lighter than any of the commercial engines hitherto produced. Further progress in this development is possible.

USE OF HIGHER-VOLTAGE SYSTEM

As the size of aircraft increases, it is inevitable that the 24–30-volt system must give way to one of higher voltage. Use of the higher-voltage system will permit tremendous saving in wiring weight, because conductors can be utilized to their maximum current capacity, and because the current required for a given amount of power is reduced. In the large aircraft which will follow in the postwar era, this change in system voltage makes possible a saving in wiring weight alone of more than one ton.

There has been much discussion as to the form which this higher-voltage system would take. The 24–30-volt system now used is direct current. The new system can be a higher-voltage direct current, for example, 110-volt, or it can be a radical departure and can utilize alternating current. The electrical industry is prepared for either. D-c 110-volt equipment has been developed, and likewise a-c equipment designed for a frequency of 400 cycles per second is also available. Astounding progress has been made in the latter. Intermittent-duty motors have a specific weight of approximately one pound per horsepower at ratings as low as eight horsepower. Continuous-duty motors of this frequency obtain a specific weight of one pound per horsepower at approximately 25-horsepower ratings. Design indicates that it is possible to build a 1,000-horsepower 400-cycle motor in the volume occupied by the ordinary waste basket. Such a motor will weigh not more than 400 pounds. At the same time the efficiency and power factor of these motors is surprisingly good. Apparently, this is due to the fact that the number of pounds in a piece of equipment decrease faster than the power loss in watts per pound increases. In practically all cases the efficiency of aircraft electric equipment compares favorably with its commercial counterpart, despite its handicap in size and weight.

POSTWAR TRENDS

As a result of these developments, the electrical industry is ready to serve the aviation industry, regardless of the trend which the latter may take. Lighter, cheaper, more reliable, and more efficient apparatus is available for any airplane from the one owned by the private individual to the great transoceanic air liners which will cross any ocean. It is quite likely that there will be a potential market for a few hundred of these transoceanic passenger liners. They will carry more than 100 passengers, and the problem of serving food to those passengers is one which is ideally answered by an electric-power system. The cooking load alone surpasses the requirements for the largest military aircraft insofar as the electric system is concerned. This type of load is anticipated, because it is believed that such luxury passenger liners as will develop in the postwar era will contain provisions for good meals in sumptuous style. More comfortable and brighter lighting will also be cause for higher electric loads. Longer-range radio equipment will contribute. This will be an ideal application for a-c equipment now being perfected by the electrical industry.

In the private airplane market, there is quite likely to be room for more than 300,000 aircraft. These will be sold to the same class of people as those who now own motorboats for their summer sport. Electric apparatus has many advantages for such aircraft, since it will be more available and less expensive than competitive types of accessory equipment.

Between these two extremes of aircraft design will be a reasonable market for transport aircraft. This market will not be so large as many enthusiasts imagine, simply because an airplane travels very rapidly. Whereas approximately seven trains are required to maintain a daily schedule between Chicago and Los Angeles and return, one airplane can accommodate the same schedule. Since the airplane does accomplish its mission in such short time, it means that the return on the investment will be correspondingly high. Therefore, it can be expected that the electrical market in the aviation industry will continue to be one of specialties. Quantities will be small, but performance requirements will be high. Since the return on the investment is high, it can be expected that a higher cost on the special electric apparatus will be justified. A transport airplane costs approximately five dollars per pound and thus far the private airplanes cost more than three dollars per pound. Electric apparatus can be evaluated on the same basis.

However, the accomplishments in the electrical industry for aviation will affect practices in widely different lines. Designers for aircraft electric equipment have learned new methods of getting more power out of each cubic inch of electric equipment, they have learned to utilize cooling most advantageously, they have learned that brushes can be worked harder, they have learned to develop and use new materials which will withstand higher temperatures, and they have learned new techniques with regard to bearings. All of these advances will be available for the design of electric apparatus for other applications, whether it be for personal, household, or industrial use.

The use of light materials is another possible improvement in postwar electric apparatus. Designers concerned with aircraft equipment are familiar with the advantages of aluminum and magnesium in the construction of end frames and other supporting portions of electric equipment. This know-how can be transferred to other types of equipment to make lighter and cheaper apparatus.

The 400-cycle development mentioned in this article may have applications in special tools and in emergency power units which are not dependent on the industrial electric system. In any case, where weight is an advantage, this system will prove its worth.

All in all it is believed that the advances which have been made by electrical designers for a specific use in aircraft will prove to have widespread and immediate benefit to designers of other apparatus, whether it be for an electric shaver, a household washing machine, or an industrial enterprise.

Photo courtesy American Airlines

INSTITUTE ACTIVITIES

AIEE Joins SAE and NASC on Aeronautical Standards

Preparation by AIEE of an informative report dealing with the fundamental characteristics of aircraft electric systems and including sections on general system layouts, system voltages and frequencies, power supply, utilization and conversion devices, distribution systems and cable circuits, control switching and protective devices, and fault-current calculations has been decided upon. This decision was reached at meetings held in September and October in New York and at Wright Field in conjunction with the Society of Automotive Engineers, the National Aircraft Standards Committee, and the National Electrical Manufacturers Association.

Participation of AIEE in the formulation of standards for aeronautical electric equipment was commenced early this year when a plan for joint efforts with other groups instigated by the Standards committee was endorsed by the board of directors, and a liaison representative, J. R. North (F '41) assistant electrical engineer, Commonwealth and Southern Corporation, Jackson, Mich., was appointed. Subsequently, meetings with SAE, NASC, and NEMA, as well as with the Army Air Forces and the Bureau of Aeronautics were held at which the respective fields of activities of the affected groups were defined. It was agreed that the particular function of AIEE would be to set up such fundamental electrical standards as methods of rating and performance characteristics of electric equipment and devices, test codes and methods of demonstrating specified performance, fundamental characteristics of aircraft electric systems, and methods of calculation.

These problems have been divided among suitable subcommittees of the air transportation committee for solution. Those subcommittees which have been listed tentatively by D. R. Shoults (M '42) committee chairman, are: aircraft electric systems; aircraft electric rotating machinery; aircraft electric control and protective devices; aircraft wires and cables; aircraft transformers, rectifiers, capacitors, and miscellaneous static devices; aircraft lighting; and aircraft electric instruments.

Considerable work concerning the determination of preferred standard voltages for aircraft rotating electric equipment already has been done during the past year by an air transportation subcommittee under the chairmanship of J. D. Miner, Jr. (M '42) engineering manager, Westinghouse Electric and Manufacturing Company, Lima, Ohio. It is expected that a proposed standard will be approved shortly for trial use.

Future AIEE Meetings

Winter Technical Meeting
New York, N. Y., January 22–26, 1945

North Eastern District Meeting
Buffalo, N. Y., April 25–26, 1945

Summer Technical Meeting
Detroit, Mich., June 25–29, 1945

SECTION • • • • •

Electronics in Peacetime Discussed in Philadelphia

Some of the ways the wartime electronic developments which have enabled utilization of ever higher frequencies will be employed successfully, and the confines set upon them by economic considerations were discussed by William C. White (M '30) head of the electronics section of the General Electric Research Laboratory, Schenectady, N. Y., before the AIEE Philadelphia Section, recently.

The extension of broadcasting and communication techniques more than tenfold upward on the spectrum of electromagnetic radiation since the war has opened up many additional frequency channels to radio and made practical such new elements as sharply directed beams with small antenna structures, Mr. White said.

With the relaxation of man power and material restriction after victory, Mr. White foresees immediate activity in the promotion of frequency modulation and television broadcasting. Since there always have been more groups interested in entering the broadcasting field than there have been suitable available frequency channels, Mr. White looks to FM broadcasting to break that bottleneck. He believes that hundreds of such stations will be put into operation as fast as they can be manufactured. Expansion of television is foreshadowed, he believes, by the fact that enough applications for transmitting-station licenses have been filed to assure regular evening programs for most metropolitan areas.

Aside from advances in radio, many new industrial developments of electronics have become technically possible, but some are economically unsound, he said. As an example he cited electronic heating, which is heat in one of its most expensive forms and, therefore, limited in usefulness. Although uneconomical for drying low-cost bulk material, its cost can be justified for a product of high unit value when time is an important factor and selective heating necessary, he declared.

Prohibitive cost also may bar many ingenious appliances from the home, Mr. White warned in mentioning one which will open a garage door for a car at the sound of its horn, or at a certain sequence of headlight flashes. However, he added, no one seriously would consider paying $250 for the contrivance.

Wilmington Subsection Plans Winter Program

A discussion of "Power Supplies for Arc Welding" and a sound film, "The Story of A-C Arc Welding," presented by R. F. Wyer of the General Electric Company, Schenectady, N. Y., comprised the program of the first regular meeting of the new Wilmington Subsection of the AIEE Philadelphia Section. Approximately 50 AIEE members, local members, and guests attended the meeting held during the first part of October.

Meeting programs for the new Subsection have been planned for the next three months. Scheduled are addresses by E. L. Harder (M '41) of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., on "A-C Generator Voltage Regulation"; by S. C. Killian (A '42) of Delta Star Electric Company, Chicago, Ill., on "Substation Design and Fuse Co-ordination"; and by E. H. Alexander (M '43) General Electric Company, on "Industrial Motor Control."

Officers of the Subsection are:

Chairman: Kennard Pinder (M '37) E. I. duPont de Nemours and Company.

Vice-chairman: R. G. Rudrow (M '41), Atlas Powder Company.

Secretary: Henry Evans (A '32), Delaware Light and Power Company.

Treasurer: W. A. Thomas (M '43), E. I. duPont de Nemours Company.

Executive committee: H. E. Houck (M '40), E. I. duPont de Nemours Company; E. R. Streed (A '33), Delaware Power and Light Company; Joseph Kunst (A '43), Dravo Corporation; and M. G. Young (A '41) University of Delaware, Newark.

Chairman of membership committee: C. F. Magee (M '44), E. I. duPont de Nemours Company.

Chairman of program committee: F. T. Bear (M '31), Delaware Power Company.

Chairman of related activities committee: E. M. Schwyter (A '36), H. Fletcher, Brown Vocational High School.

PERSONAL • • • •

J. L. Hamilton (A '15, F '21) assistant vice-president, Century Electric Company, St. Louis, Mo., has been appointed 1944–45 chairman of the Lamme Medal committee of which he has been a member since 1942. Mr. Hamilton, who was born September 24, 1883, in Morrisville, Mo., received the degree of bachelor of science in electrical engineering from the University of Missouri in 1904. From 1904 to 1915 he was associated with the Emerson Electric Manufacturing Company, St. Louis, in general electrical and mechanical designing. He was made manager of electrical and mechanical designing in 1913. In 1915 he joined the Century Electric Company as chief engineer and in 1934 was made assistant vice-president. From 1920 to 1940 he was a member of the board of directors of the company. Mr. Hamilton was elected AIEE vice-president for the South West

District 7 in 1940 and was a member of the board of directors from 1940 to 1942. His other Institute activities include service on the committee on electrical machinery for 1926–27, and from 1932 to 1942 (chairman 1936–38); and on the committee on domestic and commercial applications, 1940–43. He is the author of many technical papers and inventer of electrical and mechanical apparatus. He is a member of the American Society for Testing Materials, the National Industrial Conference Board, and the American Management Association.

J. E. Housley (A '19, M '39, F '43) district power manager, Aluminum Company of America, Alcoa, Tenn., has been appointed 1944–45 chairman of the AIEE committee on electrochemistry and electrometallurgy of which he has been a member since 1939. Born January 9, 1893, in Knoxville, Tenn., Mr. Housley was graduated from the University of Tennessee with the degree of bachelor of science in electrical engineering in 1915. He joined the Aluminum Ore Company, East St. Louis, Ill., in 1915 as apprentice electrical engineer and in 1917 became head electrical engineer. In 1921 he was made assistant power superintendent. During 1922 he was electrical sales engineer for the Aluminum Company of America, Kansas City, Mo., but in 1923 he returned to the Aluminum Ore Company to take charge of a reconstruction program. Returning to the Aluminum Company of America, Alcoa, as assistant district electrical superintendent in 1924, he was made superintendent of power in 1927. In 1943 he was named district power manager. An active AIEE member, Mr. Housley served as Section chairman of the East Tennessee Section for 1938–39, on the AIEE membership committee, 1940–41, and the industrial power applications committee for 1943–44. He was elected AIEE vice-president for the Southern District 4 in 1941. He is a frequent contributor to technical periodicals.

J. E. Housley

A. C. Monteith (A '25, M '40) manager, industry engineering department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed 1944–45 chairman of the AIEE Standards committee of which he has been a member since 1941. Mr. Monteith was born in Brucefield, Ontario, Canada, April 10, 1902, and received the degree of bachelor of science from Queens University in 1923. He joined the Westinghouse Company as central-station engineer in 1924 and in 1938 was made manager of the central-station section. In 1941 he became manager of the industry engineering department. Author of a number of technical papers he received honorary mention for the best paper in engineering practice in the 1937 AIEE prize awards. He has served on the following AIEE committees: power generation, 1938–43 (chairman, 1942–44); protective devices, 1940–42; Standards, 1941–44.

D. R. Shoults (A '35, M '42) industrial engineering department, General Electric Company, Schenectady, N. Y., has been appointed 1944–45 chairman of the AIEE committee on air transportation of which he has been a member since 1942. Mr. Shoults was born June 23, 1903, and received the degree of bachelor of science in electrical engineering from the University of Idaho in 1925. He entered the test course of the General Electric Company and, completing it in 1928, was assigned to the materials handling section of the industrial department. In 1929 he was transferred to the industrial manufacturers section and in 1940 to the aviation section. In this latter connection he spent several months with the Royal Air Force in England. In 1940 Mr. Shoults received the national prize award for the best paper in engineering practice. He is the author of other technical papers and a member of the Institute of Aeronautical Sciences.

E. W. O'Brien (M '37) vice-president of W. R. C. Smith Publishing Company and managing director and editor of *Southern Power and Industry*, Atlanta, Ga., has been appointed 1944–45 chairman of the committee on Student Branches of which he has been a member since 1942. Born June 20, 1897, in Phenix, West Warwick, R. I., he received the degree of bachelor of science in electrical engineering from Brown University, the degree of master of science in mechanical engineering from the Sheffield Scientific School, and the degree of mechanical engineer from Yale University. From 1918 to 1922 he was an instructor at Brown University, Providence, R. I., and in 1922 joined the faculty of the Sheffield Scientific School, New Haven, Conn., he was employed as consulting engineer by Jenks and Ballou, Providence, from 1925 to 1927. In 1927 he became editor of the *Southern Power Journal* and in 1933 managing director of the latter and of *Southern Power and Industry*. He was made vice-president and director of the W. R. C. Smith Company in 1936. Mr. O'Brien was chairman of the AIEE Georgia Section for 1941–42. He is a member of Sigma Xi, Tau Beta Pi, the Society for the Promotion of Engineering Education, and the American Society of Mechanical Engineers.

J. G. Brainerd (M '39) professor, Moore School of Electrical Engineering, and chairman of the division of physical sciences of the graduate school of the University of Pennsylvania, Philadelphia, has been appointed 1944–45 chairman of the AIEE committee on basic sciences of which he has been a member since 1940. Professor Brainerd was born August 7, 1904, in Philadelphia, and received his bachelor of science degree from the University of Pennsylvania in 1925 and the degree of doctor of science in 1934. Since 1925 as instructor and assistant professor he has been a member of the faculty of the Moore School, and in 1941 he was appointed associate professor. At present he also is engaged in a number of war research projects. From 1935 to 1937 he was associated with the Public Works Administration as engineer, assistant state director, and consultant of the power division. Professor Brainerd is coauthor of "Ultrahigh Frequency Techniques" and of "High-Frequency Alternating Currents" and author of a number of technical papers. He has edited two volumes of the *Annals* of the American Academy of Political and Social Sciences. He is AIEE representative to the recently established *Quarterly of Applied Mathematics* and is a member of the Institute of Radio Engineers and the American Academy of Political and Social Sciences.

F. B. Jewett (A '03, F '12) vice-president in charge of development and research, American Telephone and Telegraph Company,

E. W. O'Brien

J. L. Hamilton

D. R. Shoults

A. C. Monteith

New York, N. Y., retired on September 30, 1944. He was graduated from Throop Polytechnic Institute in 1898. In 1902 he received a doctor of philosophy degree from the University of Chicago and, in subsequent years, honorary degrees from various institutions including New York University, Harvard University, and the Case School of Applied Science. During the last year of his studies at the University of Chicago, Doctor Jewett acted as research assistant and in 1902 he became an assistant in physics and electrical engineering at the Massachusetts Institute of Technology, Cambridge. He entered the engineering department, American Telephone and Telegraph Company in 1904, and in 1908 he became transmission and protection engineer. In 1912 Doctor Jewett joined the Western Electric Company, New York, as assistant chief engineer, advancing to chief engineer in 1916 and vice-president in 1921 following his service in the United States Army during the first World War as a lieutenant colonel in the Signal Corps. He returned to the American Telephone and Telegraph Company in 1925 as vice-president in charge of development and research and in the same year was appointed president of the Bell Telephone Laboratories, New York, resigning from the latter position in 1940 to become chairman of the board of directors. Doctor Jewett is president of the National Academy of Sciences, a past president of AIEE, and has been a recipient of the Edison, Faraday, Franklin, and John Fritz medals.

Gerard Swope (A '99, F '22) honorary president, General Electric Company, New York, N. Y., resigned on September 8, 1944. Mr. Swope was graduated from the Massachusetts Institute of Technology in 1895 with a bachelor-of-science degree in electrical engineering. He also holds honorary doctor-of-science degrees from Rutgers University, 1923; Union College, 1924; and Washington University, 1932; a doctor-of-laws degree awarded by Colgate University, 1927; and a doctor-of-engineering degree from the Stevens Institute of Technology, 1929. He began his engineering career as a helper at the General Electric Company, Chicago, Ill., in 1893. In 1895 he joined the Western Electric Company, Chicago, as a design engineer, becoming general manager of the power-apparatus engineering department in 1906, general sales manager in New York in 1908, and vice-president and director in 1913. After serving in the United States Army during World War I, Mr. Swope was appointed president of the International General Electric Company, New York, and was made president of the General Electric Company in 1922. Following his retirement in 1940, he continued to serve as honorary president. Mr. Swope was the recipient of the Hoover Gold Medal in 1942.

M. J. Kelly (A '26, F '31) director of research, Bell Telephone Laboratories, New York, N. Y., has been elected executive vice-president of that company. Doctor Kelly was graduated from the University of Missouri in 1914 and in 1918 received the degree of doctor of philosophy from the University of Chicago. In the latter year he entered the engineering department of the Western Electric Company, New York, and in 1925 joined the Bell Telephone Laboratories as a research physicist, becoming director of research in 1936. **A. B. Clark** (M '19, F '30) director of systems development, has been elected a vice-president of that company. Mr. Clark was graduated from the University of Michigan in 1911 and then entered the American Telephone and Telegraph Company, New York. He transferred to the Bell Telephone Laboratories in 1934 and in 1940 became director of systems development. **R. L. Jones** (A '11, F '31) director of apparatus development, has also been made a vice-president of the Bell Telephone Laboratories. A graduate of the Massachusetts Institute of Technology in 1909, Doctor Jones entered the employ of the Bell Telephone Laboratories in 1911 and in 1928 became director of apparatus development.

W. A. Smith (A '23) formerly chief engineer, Ohio Brass Company, Barberton, has been appointed consulting engineer. Mr. Smith's first position was with Westinghouse, Church, Kerr, and Company, New York, N. Y., in 1902. He did insulator inspecting and testing in New York and Ohio for the Pacific Gas and Electric Corporation, San Francisco, Calif., from 1904 until 1906 and in 1907 became an automobile dealer, Smith Brothers, Los Angeles, Calif. Mr. Smith has been with the Ohio Brass Company since 1916 except for a period from 1924 until 1931 when he acted as an independent engineer. **J. J. Taylor** (A '37) of the engineering department has been appointed chief engineer. Mr. Taylor received his engineering degree from the University of Alberta, Canada, in 1928. From 1924 to 1926 he was a draftsman for the Canadian government in Brazeau Forest, Coldspur, Alberta. He took the test course of the General Electric Company, Peterborough, Ontario, Canada, in 1928 and then was placed in the induction-motor-design department. Mr. Taylor joined the Canadian Ohio Brass Company, Niagara Falls, Ontario, in 1930 and was transferred to Barberton, Ohio, in 1931.

E. H. Kifer (A '09, M '13) formerly business manager and engineer, San Antonio (Tex.) Board of Education, has been made general manager of the City Public Service Board, San Antonio. Mr. Kifer was graduated from the University of Wisconsin in 1908 with a degree of bachelor of science in electrical engineering. His career in public utilities began in 1903 with the Madison (Wis.) Gas and Electric Company and later he was employed by the San Antonio Public Service Company and the Binghamton (N. Y.) Gas Company. He became associated with the San Antonio Board of Education in 1937. **W. B. Tuttle** (M '30) formerly chairman of the board of directors, San Antonio Public Service Company, has been made chairman of the board of the City Public Service Board. Mr. Tuttle's first position was with the Consolidated Gas Company of New Jersey in 1896. He left to join the American Light and Traction Company, New York, N. Y., but returned to the Consolidated Gas Company in 1898. In 1918, after working for the San Antonio Traction Company and the San Antonio Gas and Electric Company, he was employed by the San Antonio Public Service Company. He was appointed chairman in 1935.

C. F. Hawker (A '20, M '25) chief engineer, Armstrong Cork Company, Lancaster, Pa., has been elected vice-president in charge of manufacture. Mr. Hawker was graduated from Ohio State University in 1917. In the same year he entered the employ of the Carolina Power and Light Company, Florence, S. C., but left to join the United States Army. He became resident engineer on construction for the Phoenix Utility Company, Hartsville, S. C., in 1919 and later assistant electrical engineer, Dayton (Ohio) Power and Light Company. In 1923 he was electrical engineer in charge of electrical design and construction, E. W. Clark Corporation, Columbus, Ohio, and successively held positions with the Commonwealth Power Corporation, Jackson, Mich., in 1926 and the Tennessee Electric Power Company, Chattanooga, in 1929. Mr. Hawker joined the Armstrong Cork Company in 1930. He was made assistant chief engineer in 1936 and chief engineer in 1937.

C. L. Kinsloe (A '08, M '13) professor and head of the department of electrical engineering, the Pennsylvania State College, State College, has retired. A graduate of Central State Normal School in 1899, Professor Kinsloe received his bachelor-of-science degree from the Pennsylvania State College in 1903 and the degree of master of science in electrical engineering in 1907. After six years in the engineering departments of Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and the Philadelphia (Pa.) Electric Company, he began his teaching career as an instructor in electrical engineering, Western University of Pennsylvania, in 1906. In 1907 he joined the staff of the Pennsylvania State College as acting head of the department of electrical engineering. Two years later Professor Kinsloe was made head of the department.

F. M. Williams (A '21, M '28) general installation engineer, Western Electric Company, Inc., New York, N. Y., retired on October 1. Mr. Williams is a graduate of the University of Minnesota, having received a bachelor-of-arts degree in 1905 and a degree in electrical engineering in 1909. He joined the student course of the Western Electric Company, Chicago, Ill., in the latter year and in 1910 was made equipment engineer. In 1922 he became assistant superintendent of equipment engineering and in 1923, superintendent. In 1927 Mr. Williams was transferred to New York as general installation engineer.

R. C. Disque (M '20) dean of engineering, Drexel Institute of Technology, Philadelphia, Pa., has been named acting president of the institute. A graduate of the University of Wisconsin in 1903 with a bachelor-of-law degree, Professor Disque joined the staff as an instructor in electrical engineering in 1908, after receiving the degree of bachelor of science in electrical engineering, and in 1913, became assistant professor. In 1919, following three years of service in the United States Army during which he attained the rank of major, he was appointed professor of engineering at Drexel Institute, and in 1925 he became dean.

L. B. LeVesconte (A '36, M '43) district engineer, central-station division, Westinghouse Electric and Manufacturing Company, Chicago, Ill., will become assistant professor of electrical engineering and chief engineer of the network-calculator laboratory, Illinois Institute of Technology, Chicago. Mr. LeVesconte joined the Westinghouse Company in East Pittsburgh, Pa., in 1927 as a member of the student course. Subsequently, he was employed in the switchboard engineering department, the relay engineering department at Newark, N. J., and in 1937 was transferred to Chicago as district engineer.

Paul MacGahan (A '02, F '42) development engineer, Westinghouse Electric and Manufacturing Company, Newark, N. J., has retired. A graduate of Columbia University in 1896 with a degree in electrical engineering, Mr. MacGahan attended the graduate student course at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., until 1897 when he was placed in the detail and supply engineering department. He was put in charge of instrument and relay engineering in 1905 and in 1925 became development engineer.

A. P-T. Sah (A '35, M' 36) president of the National University of Amoy, Changting, Fukien, China, has been decorated by the Chinese Government and awarded the plaque of the Order of the Brilliant Star for his meritorious administration of a national university during war time. Doctor Sah is also the recipient of the first Medal of Honor given by the Chinese Institute of Electrical Engineers for contributions to the science of electrical engineering.

L. A. Hawkins (A '03, M '13) executive engineer of the research laboratories, the General Electric Company, Schenectady, N. Y., has been appointed to the board of trustees of the newly established Illuminating Engineering Society Research Fund. **P. H. Daggett** (A '08) dean of the college of engineering, Rutgers University, New Brunswick, N. J., will also serve as a member of the board.

C. O. Bickelhaupt (M '22, F '28) colonel and commanding officer of the Eastern Signal Corps Unit Training Center, United States Army, Fort Monmouth, N. J., has been promoted to the rank of brigadier general. General Bickelhaupt was a vice-president of the American Telephone and Telegraph Company, New York, N. Y. when called to active duty with the Army in 1941.

F. G. Logan (A '35) chief development engineer Ward Leonard Electric Company, Mount Vernon, N. Y., has been elected vice-president and manager of research and development. Mr. Logan became associated with the Ward Leonard Company in 1925 as advertising manager and since 1929 has been engaged in development work. He was made a director in 1937, manager of research and development in 1940, and manager of the regulator division in 1941.

T. D. Reimers (M '36) electrical superintendent of the Hudson Avenue generating station, Consolidated Edison Company of New York, Inc., New York, has joined the Sheldon Service Corporation, Long Island City, N. Y., as the engineering manager. Mr. Reimers had been with the Consolidated Edison Company since 1927 and was appointed electrical superintendent in 1943.

P. L. Bellaschi (A '29, F '40) development engineer, Westinghouse Electric and Manufacturing Company, Sharon, Pa., has arrived in South America for a tour in which he will study her expanding electrical needs and inform leading South American industrialists, technical-research men, and educators of recent scientific developments in the United States.

F. B. Johnson (M '37) formerly apparatus engineer, Commonwealth Edison Company, Chicago, Ill., has been appointed assistant chief testing engineer. **J. W. Baring** (M '41) formerly head starting engineer, has been made apparatus engineer.

A. J. Haskens (M '44) formerly electrical engineer for the supervisor of shipbuilding, United States Navy, San Pedro, Calif., has joined the Lukas-Harold Corporation, Indianapolis, Ind., as a research and development electrical engineer.

W. A. Furst (A '13, M '27) formerly general contract manager, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed district representative, storage battery division, Philco Corporation, Pittsburgh, Pa.

F. E. Bodine (A '43) manager of the Salt Lake City office, Westinghouse Electric and Manufacturing Company, Salt Lake City, Utah, has been transferred to San Francisco, Calif., as manager of the company's San Francisco office.

J. A. Mahoney (M '36) major, United States Army, Washington, D. C., has been promoted to the rank of lieutenant colonel. Colonel Mahoney was formerly with the Bell Telephone Laboratories, Inc., New York, N. Y.

E. A. Hertzler (A '35) formerly in charge of the electrical engineering laboratory, Pratt Institute, Brooklyn, N. Y., has been appointed director of war research, United Electronics Company, Newark, N. J.

Dudley Sanford (A '25) assistant treasurer, Union Electric Company of Missouri, Webster Groves, has joined the general office staff of the Union Electric Company, St. Louis, as executive assistant.

H. R. Arnold (A '31) electrical engineer, Bureau of Ships, United States Navy Department, Washington, D. C., has been made an engineer in the Office of the Co-ordinator of Inter-American Affairs, Washington.

OBITUARY

S. Edgar Whitaker (A '96, M '13) partner, George H. Kingsley and Company, certified accountants, New York, N. Y., died August 10, 1944. Mr. Whitaker was born on June 3, 1870, in Medford, Mass. He was graduated from Boston University in 1890 with the degree of bachelor of arts and in 1893 received a master of arts degree from Boston University and a bachelor of science degree in electrical engineering from the Massachusetts Institute of Technology. Mr. Whitaker entered the business world in 1888 as a member of the partnership of Whitaker and Locke, which supplied textbooks to students of Boston University. In 1893 he became a bookkeeper for the assignees of Grosvenor and Richards, Boston, Mass., and in 1894, after a month in the dynamo room of the Massachusetts Institute of Technology, Boston, he entered the meter-testing department of the General Electric Company, Lynn, Mass., but left in 1896 to start a private business as electrical engineer and contractor in Fitchburg, Mass. In the ensuing years, between 1898 and 1916, Mr. Whitaker was employed by the Norfolk (Mass.) Southern Street Railway Company, the Norton and Taunton (Mass.) Street Railway Company, and the Portland and Yarmouth (Me.) Electric Railway Company; as consulting engineer, Burnett, Cummings, and Company, Boston; as office manager and assistant to the secretary, American Society of Mechanical Engineers, New York; and as consulting engineer to various clients, including the Russian Commission. In 1919 he became a cost accountant for the Philadelphia District Ordnance office, and most of the rest of his career was spent in accounting. He did public accounting in 1922 and 1923; was with the Harold B. Barnett Company, public accountants, New York, from 1927 to 1930; and was certified as a public accountant in 1935. Mr. Whitaker was a member of the Taylor Society.

Clem A. Copeland (A '97, F '40) retired member of the Los Angeles, Calif., Bureau of Power and Light, died August 18, 1944. Mr. Copeland was born in Goshen, Ind., on July 21, 1870, and was graduated from Cornell University in 1896. From 1888 to 1890 he was in the employ of the Electric Rapid Transit Street Car Company, San Diego, Calif., and then became secretary of the Westinghouse Incandescent Electric Light System of San Diego. Upon his graduation from Cornell University, he was made resident electrical engineer of the Copper Queen Mining Company, Bisbee, Ariz., and later, assistant electrical engineer of the Edison Electric Company, a predecessor of the Southern California Edison Company of Los Angeles. In 1897 Mr. Copeland was appointed associate professor in charge of electrical engineering, Stanford University, Calif. but in 1901 returned to the engineering profession as superintendent of distribution, Southern California Edison Company. Subsequently, he became a consulting engineer in Los Angeles, 1904; research engineer, Pacific Electric Railway Company of Los Angeles, 1909; assistant hydroelectric engineer, Pacific Gas and Electric Company, San Francisco, Calif., 1910; and valuation engineer, H. M. Ryllesby Company, Chicago, Ill., 1914. He entered the employ of the City of Los Angeles in the Bureau of Power and Light in 1916 and when he retired in 1940 was head of the research and records section. Mr. Copeland was the author of many papers and was a member of the Los Angeles Engineering Council of Founder Societies.

Louis T. Grant (A '99, M '18) retired consulting engineer and major in the United States Army during the World War I, died

July 15, 1944. Major Grant was born in Richmond, Va., November 27, 1860, and in 1885 was apprenticed to the Mather Electric Company, Manchester, Conn., as an erecter on the roads. He was with the Mather Electric Company until 1888 when he entered the shops of the Thomson-Houston Company, Lynn, Mass. In 1890, after an interval with the Union Switch and Signal Company, on the New York and New England railroad, he became engaged in erection work for the Thomson-Houston Company and was sent to Saltillo, Mexico, where he became manager of the Saltillo Electric Light Company. For the next 21 years Major Grant was employed in various engineering capacities in Nicaragua, Hawaii, Costa Rica, the Philippines, and Papeete, in Tahiti. He returned to the United States in 1912 as a consulting engineer in San Francisco, Calif., and in 1917 was commissioned as a captain in the United States Army. He was promoted to major in 1918 and returned to civilian life in 1921 as manager of the 12th district, United States Veterans Bureau, San Francisco. From 1924 until his retirement in 1936, Major Grant acted as a consulting engineer in San Francisco.

Daniel C. Green (M '26) chairman of the board, Cleveland (Ohio) Pneumatic Tool Company, died July 2, 1944. Born on November 16, 1884, in Patriot, Ind., Mr. Green was graduated from Purdue University in 1908. He was employed by the San Diego (Calif.) Consolidated Gas and Electric Company in 1909. In 1910 he was made manager of the Oregon Power Company at Albany, Ore., and in 1911 was transferred to Marshfield, Ore., in the same capacity. From 1913 to 1915 he was connected with the Everett (Wash.) Gas Company as vice-president and general manager and then joined the Utah Power and Light Company, Salt Lake City, as division manager. Subsequently, he was with the Fort Smith (Ark.) Light and Traction Company, the Utah Light and Traction Company, Salt Lake City; the Western Colorado Power Company, Salt Lake City; and the Electric Bond and Share Company, New York, N. Y. In 1933 Mr. Green was elected president of the Middlewest Utilities Company, Chicago, Ill., and in 1936 he was appointed chairman of the Central Service Corporation, Chicago. He became chairman of the board of the Cleveland Pneumatic Tool Company in 1942.

Neil Alan Dey (A '36) lieutenant in the Royal Canadian Navy, formerly in the engineering department, Dominion Cutout Company, Ltd., Toronto, Ontario, Canada, died August 8, 1944. Lieutenant Dey was born on January 24, 1905, in Wooler, Northumberland, England, and was graduated from Trent College in 1922 and from Faraday House in 1929. In 1922 he was an apprentice engineer for C. A. Parsons and Company, Newcastle-Upon-Tyne, England. In 1930, after completion of the graduate student test course, General Electric Company, Schenectady, N. Y., he assisted in the erection of an outdoor substation and hydroelectric installations for the Canadian General Electric Company. Lieutenant Dey became testing and development engineer for the Dominion Cutout Company, Ltd., and the Dominion Carbon Brush Company, Ltd., in 1931. He entered the Naval service in 1943.

Miles Ludlow Wright (A '25) in charge of testing laboratories, Public Service Company of Northern Illinois, Chicago, died August 9, 1944. He was born in Raymonds, Ohio, July 15, 1888, and, after taking the four-year electrical engineering course at Ohio State University, he was employed by the Jeffry Manufacturing Company, Columbus, Ohio, in 1908, in the armature-winding department and the testing department. He went to work for the North Shore Electric Company, Evanston, Ill., in 1909 and became superintendent of the meter departments of the Illinois Northern Utilities Company, Dixon, Ill., in 1912. Mr. Wright had been with the Public Service Company of Northern Illinois since 1913 and was put in charge of testing laboratories in 1935.

Laurence West Tower (A '36) Southwestern manager, Phelps Dodge Copper Products Corporation, Houston, Tex., died recently. Born in Providence, R. I., on July 6, 1896, Mr. Tower attended Brown University. In 1917 he joined the United States Navy, serving until 1920 when he became assistant superintendent of production, American Electric Works, Phillipsdale, R. I. He became associated with the Phelps Dodge Corporation in 1923 in the Habirshaw cable and wire division and about 1935 was transferred to Houston. Previously, he had been located in New Orleans, La., and Birmingham, Ala. Mr. Tower was a member of the Petroleum Electrical Suppliers Association and the Houston Engineers Club.

Alfred L. Oklund (A '35, M '40) design engineer, the Louis Allis Company, Milwaukee, Wis., died August 19, 1944. Born in Superior, Wis., on November 18, 1905, he was graduated from the Milwaukee School of Engineering in 1932 with the degree of bachelor of science in electrical engineering. After graduation he became an instructor in physics and later professor in charge of physics at the same school. He became connected with the Louis Allis Company in 1937 as an engineer. Mr. Oklund was a member of the General Engineering Council Committee and the Milwaukee School of Engineering committee on advance degrees in certificates.

MEMBERSHIP

Recommended for Transfer

The board of examiners, at its meeting on September 29, 1944, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Member

Aita, F. S., Anaconda Wire & Cable Co., Sycamore, Ill.
Beisber, M. F., transformer engr., Line Material Co., San Francisco, Calif.
Benowitz, Captain, Signal Corps, Dayton, Ohio
Bliss, Philip, electronics engr., New Britain Machine Co., New Britain, Conn.
Crawford, J. M., asst. elec. engr., Shawinigan Water & Power Co., Montreal, Que., Can.
Gilford, Edward, asst. chief, elec. div., Cox & Stevens, New York
Graybeal, T. D., asst. prof. of elec. engg., Univ. of California, Berkeley, Calif.
Green, N. J., secy., National Electric Coil Co., Columbus, Ohio
Hellmann, R. K., asst. chief engr., Connecticut Tel. & Electric Div., Meriden, Conn.
Hicks, B. C., protection engr., Shawinigan Water & Power Co., Montreal, Que. Can.
Kiltie, O., section engr., General Elec. Co., Fort Wayne, Ind.
Krefft, H. H., chief engr., Standard Transformer Corp., Chicago, Ill.
MacLean, G. D., mgr., Marlborough Electric Power Board, Blenheim, New Zealand
Martin, T. J., captain, Air Corps, Wright Field, Dayton, Ohio
Melloh, A. W., engr., Univ. of California, San Diego, Calif.
Morrison, G. K., asst. mgr., RCA., Harrison, N. J.
Muehlig, R. E., repair supt., Westinghouse E. & M. Co., South Boston, Mass.
Mulligan, J. E., asst. prof. of elec. engg., Mass. Inst. of Tech., Cambridge, Mass.
Nason, E. P., Lieut., Corps of Engrs., Ft. Belvoir, Va.
Nonken, G. C., engr., General Elec. Co., Pittsfield, Mass.
Parks, C. E., relay engr., Public Service Co. of Indiana, Inc., Indianapolis, Ind.
Pembleton, F. W., industrial engr., R. B. N. Co., Logansport, Ind.
Perry, H. I., elec. engr., General Elec. Co., New York
Plotz, R. S., member of technical staff, Bell Tel. Labs., Inc., New York
Robert, L. W., consulting engr., Bona Allen Bldg., Atlanta, Ga.
Rose, Hugh, mgr., switchgear section, Canadian General Elec. Co. Ltd., Toronto, Ont. Can.
Sage, Darrow, mechanical operating engr., Public Service Elec. & Gas Co., Newark, N. J.
Schmidt, August, application engr., General Elec. Co., Schenectady, N. Y.
Scott, J. N., elec. designer, Charles T. Main, Inc., Boston, Mass.
Shemet, A. M., telephone engr., Bell Tel. Labs., Inc., New York
Silliman, H. G., senior elec. engr., City of Seattle, Seattle, Wash.
Small, E. H., instructor, New York University, New York
Smith, W. P., Lieut., Inspector of Naval Material, Schenectady, N. Y.
Soule, C. E., electrician, Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Spease, J. F., district engr., General Elec. Co., Portland, Ore.
Stroup, C. L., elec. engr., Hubbard & Co., Chicago, Ill.
Sukachoff, A. S., elec. engr., York & Sawyer, New York
Treece, C. C., elec. engr., Louisiana Power & Light Co., Monroe, La.
Vail, C. R., instructor in elec. engg., Duke Univ., Durham, N. C.
Wallace, G. A., associate prof. of elec. engg., McGill Univ., Montreal, Que. Can.
Walmsley, A. W., design engr., Electro Metallurgical Co., Niagara Falls, N. Y.
Walther, Austin, elec. engr., C. C. Moore & Co., San Francisco, Calif.
Wendelken, W. W., elec. supt., Westinghouse E. & M. Co., Pittsburgh, Pa.
Williams, A. J., chief of elec. div., Leeds & Northrup Co., Philadelphia, Pa.
Winemiller, H. R., engr., Commonwealth Edison Co., Chicago, Ill.
Works, L. J., group foreman, Detroit Edison Co., Detroit, Mich.
Wright, R. R., associate prof. of elec. engg., Virginia Poly. Inst., Blacksburg, Va.

47 to grade of Member

The board of examiners, at its meeting on October 19, 1944, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Doyle, H. K., operating supt., Dallas Power & Light Co., Dallas, Texas
Frampton, A. H., asst. chief elec. engr., The Hydro-electric Power Commission of Ontario, Toronto, Can.
Ruth, E. S., chief engr., Edwards & Co. Inc., Norwalk, Conn.
Watts, F. W, vice-president, Great American Industries, Inc., Meriden, Conn
Winne, H. A., vice-president, General Elec Co., Schenectady, N. Y.
Wolf, H. B., Supt., Maintenance, Duke Power Co., Charlotte, N. C.

6 to grade of Fellow

To Grade of Member

Almon, C. P., chief, Power System Operations Div., Tennessee Valley Authority, Chattanooga, Tenn
Bagwell, L. R., design engr., City of Houston, Houston, Texas
Barry, J. G., asst. prof. of elec. engg., Princeton University, Princeton, N. J.
Bragunier, C. E, elec. engr., Ebasco Services, Inc., New York
Brouse, H. L., development engr., Crosley Corp., Cincinnati, Ohio
Dublin, L. I., elec. engr., U. S. Navy Dept., Staten Island N. Y.
Foote, B. R., research engr., Hartford Electric Light Co., Hartford, Conn.
Gammell, John, chief, electrical equipment branch, War Production Board, Washington, D. C.
Goldsmith, Arthur, Lieut., U. S. Naval Reserve, Fleet Post Office, Norfolk, Va.
Hibben, S. G., director of applied lighting, Westinghouse Lamp Div., Bloomfield, N. J.

Kersh, R. S., Houston Manager, Westinghouse E. & M. Co., Houston, Texas
Muzzillo, M. F., consulting elec. engr., New York
Nacinovich, T. P., Leading Technician, George G. Sharp, New York
Neal, C. W., transmission engr., Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Sigler, E. M., application engr., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Snyder, R. F., elec. engr., Goodyear Tire & Rubber Co., Akron, Ohio
Tait, W. F., asst. general manager, Public Service Elec. & Gas Co., Newark, N. J.

17 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the national secretary before November 30, 1944, or January 31, 1945, if the applicant resides outside of the United States or Canada.

To Grade of Member

Anderson, W. V., A. S. Schulman Elec. Co., Knoxville, Tenn.
Ashby, C. A., Jr. (Reelection), Blackstone Valley Gas & Elec. Co., Pawtucket, R. I.
Averitt, R. A. (Reelection), Gen. Elec. Co., Schenectady, N. Y.
Bauman, H. C., Chemical Const. Corp, New York, N. Y.
Bower, J. L., General Elec. Co., Schenectady, N. Y.
Branch, T. P., Rural Elect. Adm., St. Louis, Mo.
Brown, A. L., Jefferson-Travis Radio Mfg. Corp., New York, N. Y.
Carroll, J. G. (Reelection), Smaller War Plants Corp., Detroit, Mich.
Cooper, N. D., Westinghouse Elec. & Mfg. Co., Cincinnati, Ohio.
Cornejo R., A. (Reelection), Pub. Works Dept., Mexico, D. F., Mex.
Cotton, J. S., Federal Pr. Com., San Francisco, Calif.
Defandorf, J. L. (Reelection), Cutler-Hammer, Inc., Milwaukee, Wis.
Earle, J. W. (Reelection), General Elec. Co., Newark, N. J.
Garrison, D. (Reelection), U. S. Army, Washington, D. C.
Gemes, G. R., Electromagnetic Mfg. Co., Sydney, Aust.
Goldmark, P. C. (Reelection), Columbia Broadcasting System, Inc., New York, N. Y.
Hamilton, R. M., Austin Co., Houston, Texas
Isserstedt, G., Can. Aircraft Inst. & Acces., Leaside, Ont., Can.
Johnson, C. H. (Reelection), Gen. Elec. Co., San Francisco, Calif.
Kirkpatrick, H. J. (Reelection), Alum. Co. of Can., Ltd., Montreal, Que., Can.
Maedel, G. F. (Reelection), R.C.A. Inst., Inc., New York, N. Y.
Mahle, H. J. (Reelection), Cons. Gas Elec. Lt. & Pr. Co., Baltimore, Md.
Margetts, W. L. (Reelection), U. S. Maritime Com., Oakland, Calif.
McNicol, F. C. (Reelection), Cutler-Hammer Inc., Milwaukee, Wis.
Mellon, J. J., Clark Controller Co., Cleveland, Ohio
Milliken, C. S., Lockheed Aircraft Corp., Burbank, Calif.
Minard, C. W. (Reelection), Nebr. Pr. Co., Omaha, Nebr.
Montesinos y Ferrer, J. E., Antilla Sugar Estates, Oriente, Cuba
Morse, T. B., Mass. Inst. of Tech., Cambridge, Mass.
Moss, C. M. (Reelection), Westinghouse Elec. & Mfg. Co., Cincinnati, Ohio
Neale, E. K., Leach Relay Co., Inc., Los Angeles, Calif.
Potter, P. S., Iowa State College, Ames, Iowa
Rahmes, R. E. (Reelection), Western Elec. Co., Inc., New York, N. Y.
Rauber, W. F., Gen. Elec. Co., Philadelphia, Pa.
Reardon, K. N. (Reelection), West Penn Power Co., Pittsburgh, Pa.
Roys, C. S. (Reelection), Ill. Inst. of Tech., Chicago, Ill.
Rylance, J. H., National Defence Dept., Ottawa, Ont., Can.
Schiller, H., Gen. Cable Corp., Perth Amboy, N. J.
Scott, L. W., General Elec. Co., Charleston, W. Va.
Smith, E. E., E. I. du Pont de Nemours Co., Wilmington, Del.
Stadtfeld, N., Jr. (Reelection), Panama Canal, Balboa Heights, C. Z.
Temin, J. T., General Elec. Co., Lynn, Mass.
Trinkle, W. S. (Reelection), Sprague Elec. Co. & Allied Cont. Co., Philadelphia, Pa.
Verwoert, H. C. (Reelection), Gen. Elec. Co., San Francisco, Calif.
Vest, W. L., Jr. (Reelection), Western Mass. Elec. Co., Springfield, Mass.
Vinci, S. A., Lockheed Aircraft Corp., Burbank, Calif.
Volski, M. L., Eastern Air Devices Inc., Brooklyn, N. Y.
Welty, R., Rural Elect. Adm., St. Louis, Mo.

48 to grade of Member

To Grade of Associate

United States and Canada

1. North Eastern

Brown, J. D., Corning Glass Works, Corning, N. Y.
Dewey, M. T., Amer. Tel. & Tel. Co., Buffalo, N. Y.
Gilbert, M. M., Buffalo Niag. Elec. Corp., Buffalo, N. Y.
Hart, W. G., Gen. Elec. Co., Schenectady, N. Y.
Herzig, F. J., Com. of Mass. Dept. Pub. Util., Boston, Mass.
Miller, G. W. (Reelection), Rochester Tel. Corp., Rochester, N. Y.
Petty, H. W., Wagner Elec. Corp., Boston, Mass.
Sanderson, K. E., Draper Corp., Hopedale, Mass.
Swope, I. G., Mass. Inst. of Tech., Cambridge, Mass.
Warner, E. S. (Reelection), U. S. Engineers, Providence, R. I.
Warner, R. S., Amer. Bosch Corp., Springfield, Mass.

2. Middle Eastern

Armor, C. A., Westinghouse Elec. & Mfg. Co., Cincinnati, Ohio
Bale, D. F., I-T-E Circuit Breaker Co., Philadelphia, Pa.
Bird, R. E., Lieut., R.N.V.R., Washington, D. C.
Bloom, W. F., Dayton Pr. & Lt. Co., Dayton, Ohio
Bowman, F. G., Wright Field, Dayton, Ohio
Burchfield, W. F., Jack & Heintz, Inc., Bedford, Ohio
Cohn, M. (Reelection), Westinghouse Elec. & Mfg. Co., Baltimore, Md.
Corrigan, W. A., Delaware Pr. & Lt. Co., Wilmington, Del.
Crush, R. G., Westinghouse Elec. & Mfg. Co., Baltimore, Md.
Davis, R. K., Equipment Lab., Wright Field, Dayton, Ohio
Egee, A. H. (Reelection), E. I. du Pont de Nemours, Wilmington, Del.
Flahie, C. E., Toledo Edison Co., Toledo, Ohio
Friedrich, R. E., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Gravenstreter, P. R., Clark Controller Co., Cleveland, Ohio
Harman, N. F., Jr., B. F. Goodrich Co., Akron, Ohio
Hauenstein, C. J., Baltimore Transit Co., Baltimore, Md.
Hommel, R. E., Amer. Tel. & Tel. Co., Dayton, Ohio
Hoose, W. L., Northern Pa. Pr. Co., Towanda, Pa.
Hughes, H. M., Allis-Chalmers Mfg. Co., Pittsburgh, Pa.
Jewell, F. W., Westinghouse Elec. & Mfg. Co., Sharon, Pa.
Kautsky, N. L., Goodyear Tire & Rubber Co., Akron, Ohio
Lankford, H. B (Reelection), Penna. Water & Pr. Co., Baltimore, Md.
Lord, D. E., Naval Ord. Lab., Washington, D. C.
Mayhew, W. K., Alum. Co. of America, Cleveland, Ohio
McArthur, B. E., Alum. Co. of America, Cleveland, Ohio
Packer, W., Republic Steel Corp., Cleveland, Ohio
Payne, W. H., Jr., Howard Univ., Washington, D. C.
Ponyik, F. E., Leece-Neville Co., Cleveland, Ohio
Post, R. G., Brush Dev. Co., Cleveland, Ohio
Purcell, J. T., General Elec. Co., Philadelphia, Pa.
Ross, P. N., U. S. Navy Dept., Washington, D. C.
Schonhoff, J. A., Maryland Drydock Co., Baltimore, Md.
Snyder, W. M., U. S. Navy Yard, Philadelphia, Pa.
Story, T. H. (Reelection), Radio Corp. of America, Camden, N. J.
Swegman, W. J., Wright Field, Dayton, Ohio
Theis, C. J., Alum. Co. of America, Cleveland, Ohio
Youtz, R. N., Penna. Water & Pr. Co., Baltimore, Md.

3. New York City

Contier, E. J., Monroe Cal. Mach. Co., Orange, N. J.
Cummins, L. (Reelection), Amer. Transformer Co., Newark, N. J.
Kalloz, J., U.S.N.R., New York, N. Y.
Leggio, J., Newark Sig. Corps, Insp. Zone, Newark, N. J.
Lew, E. G., Ebasco Services, Inc., New York, N. Y.
O'Grady, J. V., Syncro Machine Co., Perth Amboy, N. J.
Sampson, J. L., Bell Tel. Labs., Inc., New York, N. Y.
Schmidt, A. H., U. S. Navy Dept., Newark, N. J.

4. Southern

Coleman, W. G., Gen. Elec. Co., Atlanta, Ga.
Frischhertz, R., Times Picayune Pub. Co., New Orleans, La.
Jemison, R. M., Interstate-Elec. Co., Shreveport, La.
Juge, A. F., Higgins Ind., Inc., New Orleans, La.
Pettyjohn, J. G., Gen. Elec. Co., Knoxville, Tenn.
Rounds, N., U.S.M.C. Air Station, Cherry Point, N. C.
Vogel, G. E., Tenn. Valley Auth., Chattanooga, Tenn.
Weaver, J. A., Tampa Shipbldg. Co., Tampa, Fla.
Williamson, R. B., Williamson Sales Co., Shreveport, La.

5. Great Lakes

Abrell, C. W., White City Elec. Co., Decatur, Ill.
Anderson, K. C., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Beck, A. E., Richmond Elec. Ltg. & Pr. Plant, Richmond, Ind.
Becken, R. W., Interstate Pr. Co., Cass Lake, Minn.
Berghs, C. J., Pub. Serv. Co. of Northern Ill., Glencoe, Ill.
Gaulke, E. C., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Johnson, G. D. S., Valier Coal Co., Valier, Ill.
Marley, G. W. (Reelection), Commonwealth Edison Co., Chicago, Ill.
Parez, J., Harnischfeger Corp., Milwaukee, Wis.
Rann, M. B., Gen. Elec. Co., Lansing, Mich.
Rypstra, B., Wilcox-Gay Corp., Charlotte, Mich.
Schoenig, L. W., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sheridan, W. T., Univ. of Minn., Minneapolis, Minn.
Stelloh, J. E., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Van Valkenburg, H. V., Anaconda Wire & Cable Co., Chicago, Ill.
Walker, J. R., Ex Cello Corp., Detroit, Mich.

6. North Central

Lang, J. T., Pub. Serv. Co. of Colo., Denver, Colo.
Neff, E. N., Pub. Serv. Co. of Colo., Denver, Colo.
O'Rourke, H. T., Mountain States Tel. & Tel. Co., Denver, Colo.
Wagner, W. W., Army Air Forces, Denver, Colo.

7. South West

Biesele R. L., Jr., Southern Meth. Univ., Dallas, Texas
Boddie, J. R., Humble Oil & Ref. Co., Baytown, Texas
Brewer, B. Y., S.W. Bell Tel. Co., Wichita, Kans.
Brown, C. P., Beech Aircraft Corp., Wichita, Kans.
Caudry, J. L., Texas Elec. Serv. Co., Fort Worth, Texas
Geen, J. M., Gulf States Util. Co., Beaumont, Texas
Gode, R. Z., Pub. Serv. Co. of Okla., Tulsa, Okla.
Laughlin, C. E., Gulf States Util. Co., Beaumont, Texas
McKey, D. B., Radio Station WKY, Oklahoma City, Okla.
Newth, H. R., Texas Elec. Serv. Co., Fort Worth, Texas
Oertli, F. J., Guarantee Elec. Co., St. Louis, Mo.
Pickett, M. J., Texas Elec. Serv. Co., Fort Worth, Texas
Powers, W. J., Amer. Tel. & Tel. Co., Tulsa, Okla.
Puls, A. E., Rural Elect. Adm., St. Louis, Mo.
Read, N. K., Texas Elec. Serv. Co., Fort Worth, Texas
Sullivant, J. E., Smoky Hill Army Airfield, Salina, Kans.
Uehlinger, J. A., Gulf States Util. Co., Port Arthur, Texas
Welborn, J. L., Houston, Lighting & Pr. Co., Houston, Texas

8. Pacific

Beck, H. R., Lockheed Aircraft Corp., Burbank, Calif.
de Beaumont, G., Production Materials Co., Los Angeles, Calif.
Eckart, K. G., Los Angeles Shipbldg. & Drydock Corp., San Pedro, Calif.
Galchutt, E. H., Graybar Elec. Co., Inc., Los Angeles, Calif.
Goodrich, T. M., Pasadena Mun. Lt. & Pr. Dept., Pasadena, Calif.
Hoag, R. O., Alum. Co. of America, Torrance, Calif.
Huskison, E. J., Cent. Ariz. Lt. & Pr. Co., Phoenix, Ariz.
Jones, J. N., Westinghouse Elec. & Mfg. Co., Los Angeles, Calif.
Mason, M. A. (Reelection), Los Angeles Water & Pr. Dept., Los Angeles, Calif.
O'Connor, R. A., Cons. Aircraft Corp., San Diego, Calif.
Quebedeaux, T. C., North Amer. Avia., Inc., Inglewood, Calif.
Spencer, J. C., Public Utilities Dept., Alameda, Calif.
Turner, J. M., U. S. Navy, San Francisco, Calif.
Wright, E. C., U. S. Navy Radio & Sound Lab., San Diego, Calif.
Wright, F. M., North Amer. Avia., Inc., Inglewood, Calif.

9. North West

Argo, E. G., Bonneville Pr. Adm., Vancouver, Wash.
Egan, L. B., Mont. Pr. Co., Great Falls, Mont.
Finley, K. G., Washington Water Pr. Co., Spokane, Wash.
LeVasseur, J. A., Mont. Pr. Co., Great Falls, Mont.
Martin, T. M. C., Bonneville Pr. Adm., Portland, Oreg.
O'Gara, E. H., Gen. Elec. Co., Spokane, Wash.
Roach, T. E., Northwestern Elec. Co., Portland, Oreg.
Shelton, C. A., Anaconda Copper Min. Co., Great Falls, Mont.
Webster, C. H., Alum. Co. of America, Spokane, Wash.
Windust, G. B., Pacific Tel. & Tel. Co., Portland, Oreg.

10. Canada

Archibald, M. C., Montreal Engg. Co., Ltd., Montreal, Que., Can.
Holden, B. R., Bell Tel. Co. of Can., Toronto, Ont., Can.
Jackson, A. H. C., Can. Johns-Manville Co. Ltd., Asbestos, Que., Can.
Kazakoff, J., Montreal Engg. Co. Ltd., Montreal, Que., Can.
Kitchen, W. H. J., Elec. Lieut., R.C.N.V.R., Midland, Ont., Can.
Mochon, J. N., Gov. of Quebec, Montreal, Que., Can.
Mooney, R. L., Square D Co. of Canada, Ltd., Montreal, Que., Can.

Elsewhere

Adams, R. G., Mex. Tel. & Tel. Co., Mexico, D. F., Mex.
Briem, E., Municipal El. Lt. & Pr. Works, Reykjavik, Iceland
Cervantes, I., Emp. de Tel. Ericsson, S. A., Mexico, D. F., Mex.
Chadha, N. S., Sub-Divisional Officer, Works Section, Indian Command
del Real, J. F., Const. y Maq. S. de R. L., Mexico, D. F., Mex.
Enrile, A. C., Mex. Tel. & Tel. Co., Mexico, D. F., Mex.
Fasen, T., A., Mex. Lt. & Pr. Co., Mexico, D. F., Mex.
Ferrer, C., B., Ing. Mecanico Electricista, Mexico, D. F., Mex.
Fowler, I. D., Univ. of Queensland, Brisbane, Aust.
French, J. E., Sydney Tech. Coll., Ultimo, Aust.
Garcia T., C., National Road Comm., Mexico, D. F., Mex.
Kenney, A. J., General Elec. Co., Ltd., Coventry, England
Leliva, R. G., Cia. Ref. de Azucar, Vina del Mar, Chile, S. A.
Margain, F., M. L., Contractor, Mexico, D. F., Mex.
Marshall, R. S., R.N.V.R., Leith, Scotland
Pena C., G., Nat. Def. Ministery, Mexico, D. F., Mex.
Popoca, C., Mex. Lt. & Pr. Co., Mexico, D. F., Mex.
Portal M., M. A., Com. Nac. de Irrigacion, Mexico, D. F., Mex.
Ramirez B., I., Mex. Lt. & Pr. Co., Mexico, D. F., Mex.
Rangel G., H., Cuban Tel. Co., Havana, Cuba
Reidl, O., Emp. de Tel. Ericsson, S. A., Mexico, D. F., Mex.
Rodriguez R., G., Nat. Bur. of Pub. Works, Mexico, D. F., Mex.
Serrano A., S., Public Lighting Office, Mexico, D. F., Mex.

Total to grade of Associate
United States and Canada, 135
Elsewhere, 23

OF CURRENT INTEREST

Chicago Conference Presages Expanding Electronic Applications

Strong indications of accelerated activity in the field of electronics after the war were much in evidence at the National Electronics Conference held in Chicago, Ill., October 5–7, 1944. More than 2,100 were registered at the conference, and capacity audiences attended the technical sessions and other activities, somewhat overtaxing some of the facilities of the Medinah Club where it was held. The conference was sponsored jointly by the Illinois Institute of Technology, Northwestern University, and the Chicago Sections of the Institute of Radio Engineers and AIEE, with the co-operation of the Chicago Technical Societies' Council. A second conference already is being planned by the same sponsors for October 1945.

A total of 50 papers was included in the 16 technical sessions of the busy $2^1/_2$-day program, covering the subject matter of electronics including latest advances in theory and some of the newest applications, insofar as these could be revealed under wartime conditions. The program included also an opening general session, two luncheons (one sponsored by the Institute of Radio Engineers and one by the AIEE Chicago Section), and a banquet. Some 1,100 persons attended the banquet and more than 1,000 each of the luncheons.

Topping the list of general subjects in number of sessions and papers was industrial electronic applications. Three sessions were devoted entirely to that subject; in addition, there was a session on industrial radiography, and a session on electronic measurements and controls dealt mostly with industrial applications. A session on ultrahigh-frequency heating reviewed progress in industrial use of electric energy at these frequencies for heat-treating and dehydrating purposes.

Although only one session was devoted exclusively to the ultrahigh frequencies, most of the sessions involved ultrahigh-frequency techniques and equipment to some extent. Two sessions outlined the latest advances in the theoretical realm, with heavy emphasis on the ultrahigh frequencies.

One session was devoted to radio, and one presented the latest advances in television, which is expected to develop rapidly after the war. Other topics to which one session each was devoted were: power applications; aids to medical science; tube development; telephone applications; and aeronautical applications.

With a few exceptions, all papers presented will be printed and bound together in the "Proceedings of the National Electronics' Conference," which will be made available to those who attended.* In addition, plans are being made for publishing some of the papers in *Electrical Engineering.*

Discussing activities at the National Electronics Conference (left to right) Earl Abbot, (A '37) General Electric Company, Chicago, Ill.; J. E. Hobson (M '41) and P. G. Andres, Illinois Institute of Technology, Chicago; W. C. White (M '30) General Electric Company, Schenectady, N. Y. Doctors Hobson and Andres were respectively chairmen of the conference executive committee and arrangement committee; Mr. Abbott was a member of the arrangement committee; and Mr. White, who is chairman of the AIEE committee on electronics, spoke at the conference luncheon arranged by the AIEE Chicago Section

BEAL ADDRESSES OPENING SESSION

An address "Electronic Research Opens New Frontiers," by Ralph R. Beal, assistant to the vice-president in charge of RCA Laboratories, sounded the keynote of the conference at the opening general session. A. B. Bronwell (A '34), chairman of the conference program committee, presided, and Dean Ovid W. Eshbach (F '37) of the Northwestern University Technological Institute, extended the official welcome to those attending.

"Research, and more research, is the order of the postwar world," declared Mr. Beal in his address. He presented an appraisal of some of the important scientific contributions to the winning of the war and predicted some of the probable directions of future electronic research.

"During the past four years science has been mobilized into a co-operative effort unprecedented in all history," said Mr. Beal. "Throughout America, industrial research and engineering have been geared in perfect harmony. Internationally, the same co-operation has been in operation. Science, therefore, has been forged into an all-powerful wheel that turns to generate victory. . . Out of the preparedness of our research scientists and engineers in electronics, have emerged new and vital weapons and new means of speeding industrial output. Radio, no longer confined to dots and dashes as in the last war, became, thanks to electronic research, the eyes and ears of our fighting machine, the voice of our high command, the directing force behind our anti-aircraft guns, the unerring guides of warplanes and warships and the means of communicating swiftly across every ocean and across every frontier.

"Electron tubes flash facsimiles of maps, documents, and photographs over great distances to aid Allied strategy. Radio broadcasting stations are voices of liberty, informing and uniting our people. Yet these are only a few of the achievements of radio and electronics. When the full story is permitted to be told, it will be an astounding chapter of scientific accomplishment."

Discussing research in the ultrahigh-frequency regions, Mr. Beal said in part: "Research in electronics and vacuum-tube circuits is bringing into use the vast radio spectrum which lies in the frequency range from 30 to 30,000 megacycles. These are the very high, ultrahigh and superhigh frequency ranges, the characteristics of which open new horizons of tremendous potentialities for exploration. . . .

* Others interested in the conference papers may obtain the "Proceedings" at two dollars per copy. To minimize bookkeeping, the conference committee would appreciate remittances with orders, which should be forwarded to Professor P. G. Andres, Illinois Institute of Technology, 3300 Federal Street, Chicago 16, Ill. It is important that orders be entered as soon as possible, as the number of copies of the "Proceedings" printed will be determined largely by advance orders.

"A service that has yet to be developed in the very high-frequency spectrum is facsimile broadcasting—radio transmission and reception of the printed page, illustrations and diagrams. This will add a service of record to the services of sound and sight to the home. . . .

"Radio and electronic developments are an indispensable aid to man in his conquest of the skyways—in attaining speed and safety in air travel. They have opened realms of vast scope to the airplane by affording freedom of movement over land and sea. . . ."

Speaking of new aids to air traffic that may be expected in the future, Mr. Beal predicted that: "Collision-prevention apparatus will indicate obstructions that may loom in the airplane's course and afford ample warning for changing the direction or elevation of the airplane to avoid collision. Electronic means for controlling the airplane itself and for connecting the controls of the airplane into guiding radio systems so that it may fly to its destination automatically are entirely feasible in the postwar period."

Turning to television, Mr. Beal declared that "into the development of this marvel of the age has gone more concentrated research than into any other modern development. . . Television has the greatest promise of service to the public of any development in the art and science of radio. With a television receiver in your home, you will become an eyewitness to interesting events and entertainment beyond your immediate horizon. From your living room, you will see the world pass in review.

"Theater television also is being prepared as a great news service. For the first time in the centuries of theater history, a method has been devised for bringing to theater audiences the thrills and drama of actual events as they occur at a distance in real life. Electronic research has made it possible to produce pictures in motion upon a theater-size screen."

Still another service with "fabulous possibilities" is industrial television, Mr. Beal said. "This application envisages the use of radio sight as the 'eyes' of factories, the means of co-ordinating and controlling giant manufacturing enterprises, and the means also of looking into places that otherwise might be inaccessible or dangerous to man. Industrial television may be used by the plant manager to observe critical operations. It may be used to follow the flow of materials and observe progress of work. It may be used in chemical-reaction chambers to make visible complicated chemical processes."

Characterizing the electron microscope as the most revolutionary laboratory tool of the 20th century, Mr. Beal said that "there are more startling inventions which have come out of radio-electronic research—developments with a wide range of industrial applications in which electron tubes play a vital role." Among the many industrial applications that he described in some detail, was what he called radiothermics—the industrial use of high-frequency power to generate heat. He pointed out how high-frequency heat had made possible the all-wood airplane and continued: "Informed observers foresee a broad field for high-frequency heating in the furniture industry after the war, particularly in the manufacture of curved laminated sections. . . ."

Mr. Beal closed with an "urgent plea that our industrial research laboratories continue to work hand in hand with our Army and Navy in peace as they have done so magnificently in war. Let us through science put new power behind the wings of the dove of peace."

WHITE ADDRESSES AIEE LUNCHEON

An address "Electronics in Industry," by W. C. White (M '30), chairman of the AIEE committee on electronics, keynoted the discussions on industrial electronic applications at the conference. Mr. White spoke at the luncheon sponsored by the AIEE Chicago Section over which Chairman R. C. Ericson (M '41) of that Section presided.

"There is much hope that all of the new ideas and developments that have resulted from the war effort can be put to use to produce new devices to minimize the postwar recession in business volume," said Mr. White. "The big question and likewise the big problem involved is how quickly can some of these new ideas and developments be brought into commercial use."

Citing as specific examples high-frequency induction heating, operation of d-c motors on an a-c supply through electron-tube control, and the use of large sealed-off rectifiers as typical examples, Mr. White called attention to the long delay between laboratory development and active commercial utilization of electronic devices in the past. As the most important reasons for this he cited the following:

1. The cynicism and stagnation of initiative that accompany a business depression.

2. Mental resistance to change.

3. The "vicious circle in new developments"—the difficulty of producing a satisfactory design without operating experience, which experience is difficult to get without first producing a satisfactory design.

4. Higher first cost and maintenance expense.

5. Ignorance of what electronic devices can do and how they operate.

6. The relatively short tube life.

7. Variation in characteristics between individual tubes of the same type.

Turning to the present, Mr. White called attention to the indispensable role that electronics equipment is playing in America's record-breaking war production, declaring that "this industrial tool has been directly responsible for saving millions of man- and machine-hours, and millions of pounds of critical materials since Pearl Harbor."

"As a result of the war," he continued, "many new military electronic devices have progressed from the idea stage to actual use in a remarkably short period of time, sometimes only a matter of months. In the light of the retarding factors mentioned, it is interesting to study this accelerated pace and try to arrive at the reasons back of it. Many of these are clearly apparent:

1. In the place of the deadening mental attitude that accompanies depression, there is instead the atmosphere of energy and a determination to get results and get them quickly.

2. In place of the normal feeling of resistance to change, there is the certain knowledge that unless we get ahead and keep ahead of our enemies we are licked.

3. The so-called vicious circle of trial and error does not exist or is taken in stride as a necessary cycle.

4. Cost and expense are minor factors if the equipment even promises to help win the war.

5. One can only guess as to how many thousands or maybe tens of thousands of men and women during the period of the war have been given intensive training in the operation, care, and maintenance of a multitude of electronic devices. Much good publicity has also helped to minimize the ignorance factor.

It is obvious that a few of these factors are not just temporary but will carry over into the postwar period and, therefore, represent net gains."

Concerning the future, Mr. White discussed some of the factors that might shorten the elapsed time between the laboratory and extended commercial use. First it must be recognized that electronics to the industrial engineer is another tool to add to his kit to use in conjunction with other well-developed methods. Another thing that must be kept in mind is that in most industrial-applications electronic devices are just one part of a larger piece of apparatus.

The place where the first trial application is to be made should be one where a high first cost and a high maintenance cost can be justified, and should be in the hands of a "friendly customer." Tubes should be designed for long life and should be operated conservatively, and continuity of operation must be designed into the equipment.

In closing, Mr. White emphasized that the problems he had discussed are not ones that cast any doubts on the future of electronics. "That future is assured. The point is we want to bring about that coming expansion in the characteristic American way which means: just as rapidly as possible."

ADMIRAL REDMAN AND GENERAL INGLES ADDRESS BANQUET "ELECTRONICALLY"

Although neither Rear Admiral Joseph R. Redman, chief of naval communications, nor Major General H. C. Ingles, chief signal officer, could attend the conference, both addressed the banquet through the medium of the electronic wire recorder. Major Lenox R. Lohr, president, Museum of Science and Industry, Chicago, delivered the feature address of the banquet, on "Triggers to Mass Action." The banquet program was opened by J. E. Hobson (M '41) chairman of the conference executive committee; after brief remarks he introduced President H. T. Heald of the Illinois Institute of Technology who presided throughout the remainder of the program.

"To say that electronics has played a major role in the war and will continue to play such a role, is a conservative statement," began Admiral Redman in his wire-recorded talk. "The scientists of the Allies have pitted their wits against the scientists of the Axis in a constant battle to devise new and effective articles of warfare and devices to deny (or counter) the enemy's use of his new weapons; this is particularly true in the field of electronics, and we believe that *our* scientists are winning their end of this war! Not only are the scientists waging this war, but also the manufacturers; the manufacturers are engineering the scientist's developments to meet the rigid requirements in the field and are then producing the articles rapidly and in the huge quantities that are needed by the combat personnel. . .

"It is no new story to you that electronics now provides the United States Fleet with vitally important instruments. Guns are controlled by electronics; ranges and deflections are computed and applied, the guns trained and elevated, and the guns fired—all by electronics. No military organization can hope for success without fast, reliable,

and secure means of communications; electronics has provided the Navy with these means of projecting the will of the commander-in-chief over both small and wide expanses of the globe. There are many other types of electronic devices used by the Navy; these applications are far too numerous to mention but, by the aid of all these electronic devices and with American boys operating them, the Navy has a record which is the envy of every navy of the world. . .

"The present war has demonstrated that we must depend upon our ability to utilize scientific developments, and that no nation from now on can hope to win a victory unless it is in possession of adequate scientific resources, both in men and in facilities. Obviously electronics is the basis of many of these scientific weapons. As the Navy Officer responsible for providing many electronic devices to the Fleet, I would welcome from you suggestions as to the manner in which we can best co-ordinate our efforts so that we will maintain and improve our leadership."

General Ingles began his recorded talk with a message of congratulation. "During the past three years," he said, "the Army Signal Corps has had to ask for some virtually impossible things from the electronic engineers of America. We needed what amounts to a new industry—the mass production of radio transmitters, in quantities that were known in peacetime only for radio receiving sets. We insisted that the performance standards of a fixed broadcasting station be embodied in two-way radio communications equipment functioning in tanks, command cars, and jeeps moving through dust and mud, and in pursuit airplanes and bombers flying over the clouds. We specified push-button tuning for many types of transmitters and receivers, with crystal control of frequencies. We wanted small sets with big outputs. We wanted versatile sets designed with a restricted choice of components. We demanded that radio accomplish miracles of which the founders of radio never dreamed—such miracles as aircraft detection, pin-point navigation, and finding the exact direction and range of a target.

"All of these remarkable things—and some others which I may not even mention—have been accomplished. And their accomplishment has had an important part in bringing about the success of our forces in the field. . .

"The necessary instruments were available to our commanders in the field because the engineers in laboratories and factories at home found ways to meet our impossible military characteristics and to conform to our very exacting military specifications. To do this meant not only hard work but more than a touch of inspiration, for our electronic development during the war has been carried out on the very borderline of physical science. The electronic industry is hardly a generation old. Yet in the last fiscal year the Army Signal Corps alone accepted deliveries of $2,355,000,000 worth of signal equipment, most of it built around electronic tubes. . .

"There are still plenty of interesting problems to exercise the proved ingenuity and resourcefulness of our electronic physicists, designers, engineers, and production men. More than ever, now, we must ask you to speed up the cycle between the laboratory prototype and the production line. A great many new technical ideas exist which should shorten the war considerably as soon as we can bring them out in the form of standard equipment. We need to put these devices in the hands of fighting men quickly, so that more of them will come home sooner to share in postwar life to which we are all looking forward."

CONFERENCE COMMITTEES

The executive committee responsible for planning the conference and carrying it to completion was headed by J. E. Hobson (M '41) of Illinois Institute of Technology. Beverly Dudley of the McGraw-Hill Publishing Company, Inc., served as secretary of the committee, and A. Crossley as treasurer. Other members of the committee were: P. G. Andres, W. M. Ballenger (M '38), R. E. Beam (A '42), A. B. Bronwell (A '34), C. A. Crowley, L. T. Hearson (A '31), R. H. Herrick, C. S. Roys, W. O. Swinyard, S. E. Winston.

Professor Bronwell served as chairman of the 21-member program committee, Professor Andres as chairman of the 10-member arrangements committee, and Mr. Dudley as chairman of the 12-member publications and publicity committee.

WAR PROGRAM • •

Help on AAF Problems Asked by National Inventors Council

A third series of military inventive problems occupying the National Inventors Council recently was released for general distribution by permission of the War Department. The problems contained in this latest series have sprung from the needs of the Army Air Forces. In inviting submission of solutions the Council pointed out that partially satisfactory answers to most of them are already available. Proposals should be forwarded to: National Inventors Council, Department of Commerce, Washington 25, D. C. The following is the list released by the Council:

1. A lightweight reliable simply installed thrust meter for aircraft installation, combined with a torque meter if possible.

2. A shock absorber that does not require the use of synthetic packing to retain the fluid in the strut.

3. Shimmyproof free-swiveling castered wheel and tire.

4. An accurate simple cable-tension reading instrument.

5. A control cable having a coefficient of expansion close to that of aluminum alloys used in the aircraft structures or an equivalent mechanism which will take up cable slack.

6. A high-precision low-friction bearing that does not involve the use of balls or rollers.

7. The development of a suitable shock mount to permit the installation of a gun camera to a caliber 0.50 machine gun to permit the photographing of objects during the time that the gun is being fired.

8. Small lightweight gasoline engine, either two or four cycle, capable of reasonable continuous operation utilizing 100-octane aviation gasoline, which may be started and operated at temperatures as low as −65 degrees Fahrenheit. Rating should be between one and five horsepower.

9. An independently operated heating unit for sea-level operation, capable of continuous operation at −65 degrees Fahrenheit for a period of eight hours. Unit should weigh one pound or less per 1,000 Btu per hour output and must deliver clean nontoxic heated air.

10. A liquid or paste good for at least 12 hours' service which will prevent the formation of ice on airplane surfaces.

11. Methods of fabricating quartz hairsprings and diaphragms for use in watches, aneroid barometers, altimeters, air-speed indicators, and rate-of-climb indicators.

12. A device for the quick release of a cargo parachute from the cargo upon contact of the cargo with the ground. This is desirable to prevent the dragging of the cargo on the ground.

13. Positive parachute-opening device, to provide automatic opening at a definite altitude above the ground.

14. Improved form-fitting flexible comfortable parachute pack for reduced weight and bulk and with tendency toward premature release eliminated, also improved wearing qualities desirable.

15. Harness with improved quick-releasing hardware, reduced weight and bulk, and increase in comfort.

16. Low-cost aerial delivery parachutes. Must withstand 200 miles per hour air-speeds.

17. Parachute-drop test instruments: Load recorder for parachute openings. Means for recording precise time of opening and rate of descent.

18. Parachute canopy redesign to reduce weight and bulk without impairing present performance.

19. A stable parachute equal in strength and simplicity of construction to present hemispherical type.

20. A release and exchange mechanism for two targets suitable for exchanging targets without loss of equipment at high speeds.

21. A tow target "hit indicator" to indicate hits and the direction and magnitude of misses for fixed, flexible, and turret aerial gunnery practice fire.

22. A tow target capable of being towed at high speeds and producing a low drag.

23. An extra flexible high-strength 1/8-inch-diameter target-towing cable that will not "birdcage."

24. Machine for running breakdown experiments on heating elements incorporated in electrically heated flying clothing. Clothing includes jackets, trousers, gloves, and shoes.

25. Design dependable thermostats for control of heating clothing to operate on direct current, small enough to be used in gloves and boots.

26. Development of an electroplating method for the deposition of a lead–indium alloy containing approximately 4 per cent indium.

27. Development of methods or apparatus for establishing the quality of glue joints in wood without testing to destruction.

28. Development of a material with the electrical properties and heat-resistant characteristics of mica.

29. Automatic ground-speed measuring devices.

30. Compact, light, and durable two-speed or variable drive for geared superchargers.

31. Shockless two-speed propeller-drive mechanism.

32. Practical variable-diameter propeller for maximum performance at sea level and extreme altitude.

33. Practical two-position or variable compression-ratio control.

34. Simple and light detonation indicator for installation in airplane.

Signal Corps in Vanguard of Normandy Invasion

Pieced together by the War Department from individual crew reports the story of the Signal Corps' part in the Normandy invasion is one of courage, endurance, and quick-wittedness under almost constant fire from enemy ground forces and strafing from the air. Neither the proximity of large oil dumps and high explosives likely to be set afire by enemy shells nor the inconvenience of having the tires shot off their jeeps delayed nor deterred the crews from their task of laying wire. The wire network kept pace with the invasion.

Signal Corps infantry crews put ashore with the first invasion forces as well as air-

borne Signal Corps men landed by parachute and glider soon had a labyrinth of intercommunication lines set up for the dispersed invasion units. Hundreds of local lines ran along every country lane and crisscrossed orchards and barley fields. French cement poles, usually placed much too close to the roads to permit passage of Army vehicles, had to be used for stringing the wires at first. Gradually these were replaced by larger wooden poles shipped from American lumber yards. Small "rapid" pole lines were erected at intervals between the larger poles to take up the slack of the innumerable dangling wires so that they would not be cut by trucks skidding on the muddy country roads.

As fast as the enemy knocked out the lines the signalmen repaired them. All telephone wires were checked four times daily by trouble shooters, using portable Signal Corps telephones, and so efficient was this service that the trouble shooters could inform the wire patrol crews of the exact point between two poles at which a break occurred. Once the break was located, a lapse of but a few minutes brought a repairman to the spot.

The air-borne Signal Corps men, veterans of the Sicilian and Italian campaigns, laid 3,000 miles of wire and repaired 85 radios while the Allied action was at its height in Normandy.

AAF Sells Surplus Equipment. Raw and fabricated materials, standard parts, motors, hardware, fabrics, precision tools, equipment, and other surplus stocks are being offered for public sale by the Army Air Forces. Companies interested in the materials desiring to have their names placed on the active bidders list should write to: Army Air Forces, Air Technical Service Command, Midwestern Procurement District, Municipal Airport, P. O. Box 117, Wichita, Kans.

War Department Offers Speakers Through New Speakers Branch

A new Army Speakers' Branch which will make available army combat veterans from all theaters, especially the Southwest Pacific and China-Burma-India theaters, who will speak before major industrial groups and similar organizations, has been opened in Washington, D. C., according to an announcement issued by the War Department.

Colonel Warren J. Clear, General Staff Corps, who served as Military Attache to the American Embassy in Tokyo, Japan, for nine years preceding the war, is chief of the Speakers' Branch. Colonel Clear is a veteran of Bataan and Corregidor and returned a short time ago from a visit to the combat fronts in France as an observer for the Under Secretary of War. Other speakers currently available include: Lieutenant Colonel Charles W. Kerwood, air ace; Lieutenant Colonel Timothy A. McInerny, Infantry, recently returned from the European theater; Lieutenant Colonel Roswell P. Rosengren, Engineers Corps, commander of the Supreme Headquarters Allied Expeditionary Forces Courier Service in the invasion; Lieutenant William S. Spector, Medical Administrative Corps, a veteran of Guadalcanal; and Sergeant Meyer Bernstein, Infantry veteran.

Large organizations, related either directly or indirectly to the prosecution of the war, may request speakers through Captain Alvin Grauer, Speakers' Branch, Industrial Service Division, Bureau of Public Relations, War Department, Pentagon Building, Washington, D. C.

Means of Protecting Military Equipment From Fungi Studied

A fungus farm for studying means of combating the threat of wear and breakdown inherent in colonies of fungi collecting on delicate military equipment has been established by the General Electric Company in its laboratories in Schenectady, N. Y.

The danger is particularly great in the tropics where the warm moist atmosphere favors fungus growths. Fungus colonies feed on electrical insulation, often causing short circuits. They clog machinery and throw off a by-product which forms an acid strong enough to corrode metallic and electrical parts.

Since the natural conditions which retard the growth of fungi—humidity 75 degrees below atmospheric humidity, a surface spotlessly free of dust, and watertight casing—are almost impossible to reproduce in the theaters of war, the company's scientists are experimenting with waxes, varnishes, and lacquers which will have a toxic effect on the growths. Although several fungicidal varnishes have been developed, no one has been found to meet all the desired requirements. To be completely effective, a fungicide would arrest the parasitic growth, be nonpoisonous to human beings, and be noncorrosive, permanent, and colorless.

Permanency is a quality especially difficult to capture. Whereas present fungicides will continue to be effective for several months at room temperature, they lose their power in a day or two in temperatures from 120 to 140 degrees.

INDUSTRY

Research Fellowships Established in F. B. Jewett's Name

A trust fund to finance five annual postdoctorate fellowships in physical science has been established by the American Telephone and Telegraph Company, New York, N. Y., in honor of Frank B. Jewett, retired vice-president of that company and president of the National Academy of Sciences.

The fellowships, which provide an annual honorarium of $3,000 to the holder and $1,500 to the institution which he selects, enable the recipient to devote a year or so following his doctorate to research in pure science. It normally will be awarded to those who have obtained the doctorate within the preceding year or who expect to receive that degree not later than the beginning of the next fellowship term (July 1). The awards will be made on recommendation of the Frank B. Jewett fellowship committee, consisting of seven members of the scientific staff of the Bell Telephone Laboratories, which will base its selections primarily on the demonstrated research ability of the applicant, the fundamental importance of the problem he proposes to attack, and the likelihood of his growth as a scientist.

WPB Approves Manufacture of Turbines for Soviet Union

Approval of the manufacture in this country of nine hydroelectric turbine generators for the Dnieprostroi plant in the Soviet Union has been announced by the War Production Board.

The turbines, which will replace those destroyed by the Russians when they retreated before the Germans in 1941, have a total capacity of 900,000 horsepower and will require at least four years to manufacture and nstall. According to the WPB, this machinery will not be provided through lend-lease but will be financed by Russia, and its manufacture will not be permitted to interfere either with wartime production or with any important phase of reconversion.

Kerite Company Stock Purchased. It has been announced that Lee Higginson Corporation has purchased all of the stock of The Kerite Insulated Wire and Cable Company, Inc., sole manufacturers of Kerite insulation, a product used in railroad, power, and telegraph services, as well as in submarine and electronic applications. The company's present policies and management will be continued, the announcement states.

OTHER SOCIETIES

ASTM to Publish 1945 Issue of Standards in 1944

Publication of the 1945 Book of the American Society for Testing Materials Standards has been advanced a full year and the book, which is normally issued on a triennial basis, will come out in December 1944. Advancement of the publication date is the result of the heavy demand, occasioned by war production, for the

Future Meetings of Other Societies

American Society of Mechanical Engineers. Annual meeting, November 27–December 1, 1944, New York, N. Y.

American Standards Association. Annual meeting, December 8, 1944, New York, N. Y.

National Exposition of Power and Mechanical Engineering. November 27–December 2, 1944, New York, N. Y.

Institute of the Aeronautical Sciences. Fall meeting, November 1944, Dayton, Ohio; 13th annual meeting, April 1945, Detroit, Mich.

National Industrial Chemical Conference and Third National Chemical Exposition. November 15–19, 1944, Chicago, Ill.

Pacific Coast Electrical Association. Annual fall conferences: northern section, November 9, 1944, San Francisco, Calif.; southern section, November 16, 1944, Hollywood, Calif.

1942 Standards and its Supplements. The ASTM Standards provides specifications and tests for a wide range of engineering materials and will cover 6,000 pages in three parts: metals, nonmetallic materials (constructional), and nonmetallic materials (general).

Pamphlet Describes ASHVE Research Program

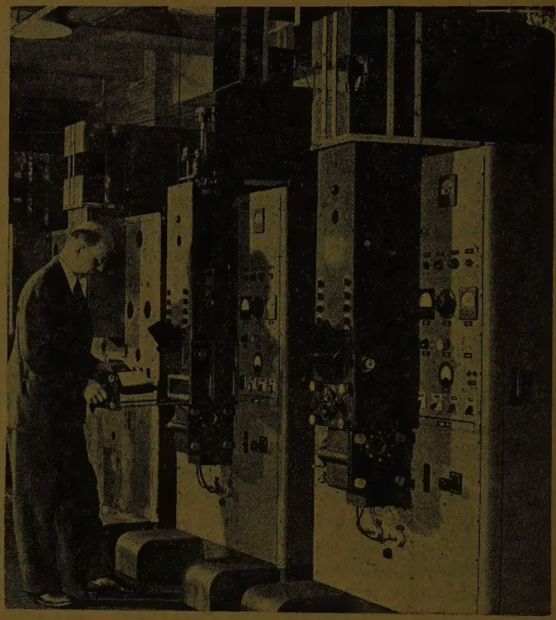
Details on the 28 research projects approved by the committee on research of the American Society of Heating and Ventilating Engineers are given in a new 32-page booklet.

A brief statement of purpose is included for each project followed by a more detailed account of the technical plan covering specific objectives, type of research, and the general method of procedure. A description of the new research laboratory in Cleveland, Ohio, a list of the committee personnel, and a list of the planned projects and the research in progress also appear. The society's research is supported by members' dues, contributions, and agreements for co-operative research. Samuel R. Lewis of Chicago, Ill., has been named chairman of the research finance committee.

Specifications for Glass Insulators. A series of specifications covering various types of glass insulators, namely, Standard Tests for Pin-Type Lime Glass Insulators, Tentative Methods of Testing Glass Spool Insulators, and Tentative Specifications for Low- and Medium-Voltage Pin-Type Lime Glass Insulators, has been developed by the American Society for Testing Material's committee on electrical insulating materials. The new emergency specifications supplement these standards by covering communication and signal pin-type materials and were developed in co-operation with the Signal Corps and United States Army Specifications 71-4953.

Cold-Cathode Tube Emits 50,000-Volt Beam

A 50,000-volt beam generated in a cold-cathode tube investigates electrical phenomena ranging from the spark of an ignition system to lightning striking a transmission line in this new electronic oscillograph built by the Westinghouse Electric and Manufacturing Company for aircraft engine manufacturers, research laboratories, and electric-power companies. The beam records its story upon a fixed or rotating film which is exposed by a photoelectric control for one revolution only, although the film-drum speed is variable up to 7,000 rpm.



JOINT ACTIVITIES

R. E. Flanders Selected as 1944 Hoover Medalist

The Hoover Gold Medal for 1944, awarded to an engineer "for distinguished public service," has been conferred upon Ralph E. Flanders, president, the Federal Reserve Bank of Boston, Mass., and president (on leave) of the Jones and Lamson Machine Company, Springfield, Vt.

Mr. Flanders has been active in the engineering field since 1897 when he was a draftsman in Providence and Woonsocket, R. I. He received the degree of mechanical engineer from the Stevens Institute of Technology in 1932 and in subsequent years has been awarded many honorary degrees. In 1912 Mr. Flanders joined the firm of Jones and Lamson as director and manager and by 1933 had attained the presidency of that company. He was granted a leave of absence in 1940 to serve as president of the Federal Reserve Bank of Boston.

Mr. Flanders is a past president of The American Society of Mechanical Engineers and is a member of the Franklin Society. He was the 1934 recipient of the Worcester Reed Warner Medal and in 1942 shared the Edward Longstreth Medal.

The Hoover Medal was instituted by the late Conrad N. Lauer and its first presentation was made to Herbert Hoover (HM '29) in 1930 to commemorate Mr. Hoover's "civic and humanitarian achievements." Other AIEE members who have been Hoover medalists are: Gano Dunn (A'91, F'12), 1939; and Gerard Swope (A'99, F'22), 1942.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

The Electric-Power Industry After the War

To the Editor:

Mr. T. G. LeClair, whose article appears in the September 1944 issue of *Electrical Engineering*, pages 338–341, entitled, "The Electric-Power Industry After the War," follows a growing practice in applying the name "electrostatic" heating to the heating of dielectric materials or materials with poor conductivity by means of radio-frequency currents. How such a misnomer was originated is difficult to understand, when one considers that the driving voltage oscillates at a rate of millions of cycles per second and at times even at hundreds of millions of cycles per second. Consider the bewilderment of the unsuspecting searcher for knowledge who may peruse a text on electrostatics from cover to cover without finding a single sentence which applies to radio-frequency heating. Although I have no concrete suggestion to offer, it seems appropriate that the AIEE Standards committee consider the problem of producing a suitable descriptive name which has a technically correct basis.

GEORGE H. BROWN (M'41)

(Research engineer, Radio Corporation of America Laboratories, Princeton, N. J.)

Industrial Research Under Free Enterprise

To the Editor:

I have read the letters in the September issue of *Electrical Engineering* commenting on "Industrial Research Under Free Enterprise" very carefully and find them very interesting.

It seems to me that your editor's note replies quite adequately to the communications of Donald G. Worth and Roy C. Dwyer.

Mr. Ford W. Harris' comments upon socialistic trends in this country remind me that our American socialists who "point with

pride" to the accomplishments of Russia generally overlook the fact that Russia, after a lot of costly experiments in Marxian socialism which resulted in the starvation of some millions of Russians, belatedly realized that human beings do not respond to efforts which tend to reduce great masses of people to common low levels but that national growth and progress can be stimulated and assured by a proper application of incentives.

The great progress in education and training and development of industrial and military establishments in Russia took place after the Russians installed effective incentives at every level of their social, economic, political, and military structures.

Our American communists and fellow travelers seem to advocate exactly the philosophy that Russia tried and found wanting, and, during exactly the period of time in which Russia has moved forward so spectacularly as the result of applying effective incentives, American democracy has been going downhill through the destruction of incentives.

Ironically enough, much of the incentive philosophy which now is accepted so broadly in Russia had its origins in the fundamental American philosophy.

Of course, there isn't the slightest justification for believing that Russia is moving away from stateism toward capitalism. She is simply applying incentives effectively to make communism work while we are destroying democracy as we destroy incentives.

I sincerely hope that your excellent publication will continue its policy of publishing controversial material. More open debate of such subjects may be the means of converting heat into light.

LOUIS RUTHENBURG

(President, Servel, Inc., Evansville, Ind.)

To the Editor:

It is probably unnecessary for me to write you, as you seem to have decided on a course of action which I think is good, but as the matter is controversial, I will let you know my reaction to two of the letters to the editor on Mr. Ruthenburg's article in the September issue of *Electrical Engineering*.

As I read Mr. Dwyer's letter I thought of suggesting that you take a poll of the membership of the AIEE on the question. From what little I know of the membership I believe that such a poll would go strongly against Mr. Dwyer. But after reading your note below it, I saw that it was unnecessary, for you intend to go placidly on your way in spite of what he wrote. I agree with you entirely on the position you have taken. It should be remembered that if a member doesn't happen to like an article that is printed in *Electrical Engineering* he doesn't have to read it, and he shouldn't set himself up to dictate what the other members should read. They are all intelligent men trained in scientific thought, and of course would consider both sides of a question.

Evidently Mr. Ruthenburg's paper hit Mr. Worth where it hurt. Since he is a Government employee, it is easy to see how he would feel; this is not the case with Mr. Dwyer, as I don't believe the Aluminum Company of America is a part of the Government as yet. But I think he should conceal his feelings as best he can, unless he is prepared to give a logical and reasonable rebuttal. Too many of the Government people seem to think that their ideas and acts should be above criticism, in fact that it is little short of sacrilege for the "common herd" to do so. To me this is a preposterous attitude which should be discouraged.

There is no necessity for any discussion of Mr. Ruthenburg's article on my part. When I read it, I thought that it was very timely; contained much food for thought and some items of information that were new and interesting to me. I was very glad to see a reference to a book on human engineering, and considered the article as a whole to be a real contribution to the subject.

As I have thought for some time that the present chaotic and generally unsatisfactory condition of this country, and even of the whole world, at the present time, has been caused by the lag of the social sciences behind what I term the material sciences, I have been greatly pleased by the papers in *Electrical Engineering* on social questions, especially on account of the men of known engineering ability who have written them. I have found them very encouraging, like a light on a dark night. However, I have noticed that they have seemed to drop off in number since we got into the war, possibly because the members are too busy with other things. This new branch of science, human engineering, interests me greatly, and I believe has some wonderful possibilities.

HAROLD L. DEYOE (A '30)

(Draftsman, service inspections and records, Consolidated Edison Company of New York, Inc., New York, N. Y.)

NEW BOOKS • • •

The following new books are among those recently received from the publishers. Books designated ESL are available at the Engineering Societies Library; these and thousands of other technical books may be borrowed from the library by mail by AIEE members. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books. All inquiries relating to the purchase of any book reviewed in these columns should be addressed to the publisher of the book in question.

Air Conditioning and Refrigeration. By B. H. Jennings and S. R. Lewis. Second edition. International Textbook Company, Scranton, Pa., 1944. 517 pages, illustrated, 9 by 6 inches, fabrikoid, $4.50. (ESL.)

The first edition of this book, published in 1939 as, "Air Conditioning, Principles and Practice," aimed to present the fundamentals of air conditioning so as to provide engineering students and practicing engineers with a sufficient basis for work in this field. This new edition has been thoroughly revised and modernized and the information on refrigeration greatly extended, so that the book also can serve as a text on that subject.

Arc and Acetylene Welding. By H. Kerwin. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1944. 240 pages, illustrated, 8 by $5^1/_4$ inches, cloth, $2.50. (ESL.)

This book is designed for beginners or for instructors who understand the technical problems of welding but not its practical aspects. This course presents, step by step, the procedure necessary to make satisfactory acetylene and arc welds, emphasizing proper technique. In addition to basic methods applications to aircraft and pipe welding, cast-iron welding, and alloy welding are treated.

Automatic Control Engineering. By E. S. Smith. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1944. 367 pages, illustrated, $8^1/_2$ by $5^1/_4$ inches, cloth, $4. (ESL.)

This book brings together, for the first time in the English language, a general discussion of processes of control, control mechanisms, and servomechanisms. Its purpose is to provide tools to aid in the solution of problems in automatic regulation wherever they occur. The subject is approached first qualitatively and then is analyzed quantitatively. Appendixes provide a review of basic physics and the mathematics of physical transients.

Down to Earth. By D. Greenhood. Holiday House, New York, N. Y., 1944. 262 pages, illustrated, $11^1/_4$ by $8^1/_2$ inches, cloth, $4. (ESL.)

This book, written for the amateur, provides a general survey of maps and map making. The theories and techniques of mapping are developed in simple language, clearly and explicitly. Directions are given for making maps and for collecting them. The book is illustrated profusely and will interest map makers and users alike.

Engineering Materials Annual 1944. Edited by H. H. Jackson. Paul Elek (publishers) London, W.C.2, England. 108 pages, $8^1/_4$ by 5 inches, cloth, 8*s*.6*d*. (ESL.)

This manual gives a concise review of important developments in engineering materials during the year 1943. It includes articles on ferrous and nonferrous metals, plastics of all kinds, ceramic materials, fuels, lubricants, plywood, and adhesives. Each review is accompanied by a bibliography.

Engineering Production Annual 1944. Edited by H. H. Jackson. Paul Elek (publishers) London, W.C.2., England. 102 pages, $8^1/_4$ by 5 inches, cloth, 8*s*.6*d*. (ESL.)

This short volume reviews developments during 1943 in machine-shop methods, machine tools, welding, powder metallurgy, hardening, and so forth. Each review is accompanied by a list of references to the articles from which the review was prepared.

Explosions, Their Anatomy and Destructiveness. By C. S. Robinson. McGraw-Hill Book Company, New York, N. Y., and London, England, 1944. 88 pages, illustrated, $8^1/_2$ by 5 inches, cloth, $1.50. (ESL.)

For the benefit of all those who may have contact with explosives, this small book describes the sequence of events that lead up to an explosion, the phenomena produced, and the effects of these phenomena on the surroundings. A brief study of a large number of notable explosions is included.

Fields and Waves in Modern Radio. By S. Ramo and J. R. Whinnery. John Wiley and Sons, Inc., New York, N. Y.; Chapman

and Hall, London, England, 1944. 502 pages, illustrated, $8^1/_2$ by $5^1/_2$ inches, cloth, $5. (ESL.)

This book is concerned with certain aspects of electromagnetic theory in their relations to the problems of modern radio and electronics engineering. The first six chapters discuss the electromagnetics of the lower frequencies and provide an introduction to the treatment of the higher frequencies in succeeding chapters. These later chapters cover the propagation and reflection of electromagnetic waves, characteristics of wave guides and transmission lines, resonant cavities, and radiation.

Grosse Masszahl und Einheit. By M. Landolt. Rascher and Cie Verlag, Zürich, Switzerland, 1943. 85 pages, tables, 8 by $5^1/_4$ inches, paper, 5.80 francs. (ESL.)

This small book deals with the methods of handling quantities, such as lengths expressed in meters, output expressed in horsepower, and so forth, in various calculations, as distinguished from calculations using pure numbers only.

Marine Radio Manual. Edited by M. H. Strichartz. Cornell Maritime Press, New York, N. Y., 1944. 518 pages, illustrated, $7^1/_2$ by 5 inches, fabrikoid, $4. (ESL.)

This manual provides a detailed comprehensive account of the duties of the ship radio officer. The text is clear and readable, and covers the fundamentals and advanced duties. In addition to being a text for the beginner, it will be useful to the commissioned officer for reference.

Metallography of Some Aluminium Alloys. (Association series number RRA 635.) By M. D. Smith. British Nonferrous Metals Research Association, Euston St., London, N.W.1, England, November 1943. 12 pages, illustrated, $9^3/_4$ by $6^1/_4$ inches, paper, 2*s*. (ESL.)

This brochure describes work on the constitution and metallography of aluminium alloys in common use. Cooling curves were taken, and the structure of the alloys examined in the cast condition and after quenching from various temperatures. There are 28 photomicrographs.

Municipal Index and Atlas. Nineteenth Annual Edition—1944. American City Magazine Corporation, New York, N. Y. 663 pages, illustrated, $10^1/_4$ by 7 inches, fabrikoid, $5. (ESL.)

This volume, like preceding issues, is intended as a reference manual for municipal officials. Under such headings as streets and highways, water supply, sewage and garbage collection, lighting and power, public safety, recreation, and business machines, it reviews recent developments in municipal affairs. Manufacturers' data are included.

Ordinary Differential Equations. By E. L. Ince. Dover Publications, New York, N. Y., 1944. 558 pages, illustrated, $9^1/_4$ by $5^1/_2$ inches, fabrikoid, $3.75. (ESL.)

This book originally appeared in 1927 and at once was accepted as a standard work on its subject. It has been out of print for some time, and this edition, costing about one fourth the original price, will be welcomed by mathematicians, engineers, and others.

Physics of the 20th Century. By P. Jordan, translated by E. Oshry. Philosophical Library, New York, N. Y., 1944. 185 pages, $8^1/_2$ by $5^1/_2$ inches, cloth, $4. (ESL.)

This book, which appeared in Germany a few years before World War II, aims to give a complete picture of modern physics in broad outline. Attention is concentrated on the underlying ideas that have guided the efforts of physicists from the time of Galileo to the present day.

Plastic Working of Metals and Nonmetallic Materials in Presses. By E. V. Crane. Third edition. John Wiley and Sons, Inc., New York, N. Y.; Chapman and Hall, London, England, 1944. 540 pages, illustrated, $8^1/_2$ by $5^1/_2$ inches, fabrikoid, $5. (ESL.)

In this edition the author has expanded his work on sheet-metal working and forging to include powdered metals, synthetic plastic powders, and other materials now worked plastically. The methods used in working these materials are studied and described in considerable detail, and an effort is made to classify the metal-working operations into groups and to establish a working theory for predicting results with various materials.

Results of Publicly Owned Electric Systems. Burns and McDonnell Engineering Company, Consulting Engineers, Kansas City, Mo., 1944. 447 pages, illustrated, 9 by $6^1/_4$ inches, paper, $10. (ESL.)

This handbook gives the records for the year 1943–44, of publicly owned electric utilities in 767 American cities. Operating data and rates are given. Other features are a comparison of rates of publicly owned and private systems, accounts of the results of public power developments in the Northwest and in the Tennessee valley and of the work of the Rural Electrification Administration.

SAE Handbook, 1944 Edition. Society of Automotive Engineers, 29 West 39th St., New York, N. Y., 1944. 804 pages, illustrated, $8^1/_2$ by $5^1/_2$ inches, fabrikoid, $5. (ESL.)

The 1944 edition gives the officers and committees of the Society and also contains the standards at present adopted by the organization.

Symposium on the Applications of Synthetic Rubbers. American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa. 134 pages, illustrated, 9 by 6 inches, paper, $1.50, cloth, $1.75; to ASTM members, paper, $1, cloth, $1.25. (ESL.)

This pamphlet contains 13 papers presented at the Cincinnati, Ohio, meeting of the Society in March 1944. The purpose was an authoritative presentation of present knowledge of synthetic rubbers which will aid users in the selection of the best material for various purposes. Among the subjects are: the origin and development of synthetic rubbers; their physical testing and properties; processing characteristics; use in making extruded products; tires and inner tubes; belting and hose; cellular products; hard rubber products; uses in wire and cable; footwear; adhesives.

Fundamentals of Telephony. By A. L. Albert. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1943. 374 pages, illustrated, $8^1/_2$ by $5^1/_2$ inches, cloth, $3.25. (ESL.)

This is an elementary text on wire telephony only, intended for beginning students and telephone workers rather than for trained engineers.

PAMPHLETS . . .

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

Four Years' Pioneering in Plastics Education. Plastics Industries Technical Institute, 122 East 42nd Street, New York, N. Y., 16 pages.

Reconversion. By James F. Byrnes. Office of War Mobilization, Washington, D. C., 14 pages.

Facts for Industry, Series 50-3-1. Bureau of Census, Washington 25, D. C., 30 pages.

Bibliography of Industrial Engineering and Management Literature. By Ralph M. Barnes and Norma A. Englert. University of Iowa, Iowa City, 80 pages, $1.50.

Sixteenth Report to Congress on Lend-Lease Operations. United States Government Printing Office, Washington, D. C., 88 pages.

A Suggested Street Lighting Plan Book for Utilities. National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., 56 pages, $1.

Light Metals and Stainless Steel. Pennsylvania Department of Commerce, State Planning Board, Harrisburg, Pa., 44 pages.

Some Characteristics of Acid Regenerated Carbonaceous Zeolite. By Frank N. Kemmer and Joseph Thompson. The Cochrane Corporation, Philadelphia, Pa., 5 pages, no charge.

Metal Quality. Drop Forging Association, 605 Hanna Building, Cleveland, Ohio, 40 pages.

Low Cost—the Key to Full Postwar Employment. By Albert Ramond. Albert Ramond and Associates, Inc., Chrysler Building, New York 17, N. Y., 15 pages.

Oil Circuit Breaker Bushing Test Practice. By Ernst J. Mommo. Public Service Electric and Gas Company, Maplewood, N. J.

Keeping Air Circuit Breakers in Trim. I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa., 8 pages.

Working Principles of Electric Arc Welding. Harnischfeger Corporation, Milwaukee 14, Wis., 68 pages, $1.